

Physical Fitness and Psychological Stress Among University Students: A Cross-Sectional Observational Study

P. Reddy Haritha¹, Dr. K. Madhavi²

¹BPT Internee, SVIMS University, Tirupati

²MPT (CT), Ph.D., Professor & Principal, College of Physiotherapy, SVIMS University

Abstract: Background: Sedentary study routines and academic pressure may reduce physical fitness and increase psychological stress in university students. Physiotherapy-based exercise is a proposed non-pharmacological approach, but the current fitness and stress profile of students, and how the two relate, is not well described. Objective: To describe physical fitness (BMI, flexibility, muscular endurance) and psychological stress in students aged 17–25 years, to compare stress across domains and by sex, and to examine fitness–stress associations. Methods: In this cross-sectional observational study, fitness data from 52 Bachelor of Physiotherapy students (41 females, 11 males) and responses to the 40-item Student Stress Inventory (SSI) from 51 students were analysed. Stress domains were compared by repeated-measures ANOVA with Bonferroni-adjusted paired t-tests; sex differences were tested with Welch's t-test and the Mann–Whitney U test; associations were tested with Pearson and Spearman correlations, with Holm adjustment ($p < 0.05$). Results: Mean age was 20.46 ± 2.23 years and mean BMI 22.72 ± 4.64 kg/m²; 42.3% of students were outside the normal BMI range (19.2% underweight, 23.1% overweight or obese). Mean total stress was 85.2 ± 19.6 out of 160 (Cronbach's $\alpha = 0.91$). Domain scores differed ($F(3,150) = 15.51$, $p < 0.001$, partial $\eta^2 = 0.24$): environmental stress was highest and remained significantly higher than every other domain after Bonferroni correction. Stress did not differ by sex (all $p \geq 0.29$). Males had higher weight (63.96 ± 12.20 vs 55.41 ± 10.62 kg; Mann–Whitney $p = 0.027$) and BMI (25.43 ± 5.50 vs 22.00 ± 4.17 kg/m²; $p = 0.043$), although Welch's t-test was borderline ($p = 0.052$ and 0.076). Flexibility correlated with environmental stress ($r = 0.31$, $p = 0.028$), which was not confirmed by Spearman correlation ($p = 0.092$) or after Holm adjustment ($p = 0.42$). Conclusion: Students showed moderate stress, mainly environmental, and a substantial proportion had abnormal BMI, with no robust fitness–stress associations. These findings support screening students for weight status and stress and provide reference data for future studies, including intervention trials of physiotherapy.

Keywords: physiotherapy; physical fitness; psychological stress; university students; flexibility; muscular endurance; BMI

1. Introduction

Students face academic workload, examinations, social expectations and long periods of sitting and screen use, which can reduce physical activity and impair both physical fitness and psychological well-being. Insufficient physical activity is widespread: WHO data report that about 31% of adults and roughly 80% of adolescents worldwide do not meet recommended activity levels [1–3], and India's 2024 physical activity profile estimates inactivity in 49.4% of adults, higher among females (57.2%) than males (42.0%) [4].

Physical fitness comprises cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition, and supports daily functioning, energy and disease prevention [5]. Psychological stress arises when perceived demands exceed perceived coping ability; in students it is commonly linked to academic, interpersonal, physical and environmental factors and is associated with poor sleep, fatigue, reduced concentration and lower academic performance [6,7]. In India, a meta-analysis of 43 studies of undergraduate medical students reported a pooled stress prevalence of about 50%, with females more affected than males [8].

Exercise-based approaches are increasingly proposed to manage student stress. A meta-analysis of randomised trials in university students found that physical exercise reduced stress (SMD = -0.46 , 95% CI -0.64 to -0.28), with the largest effects in programmes lasting 10–48 weeks [9]. A network

meta-analysis of 25 trials (2,127 students) likewise associated exercise with lower depression, anxiety and stress, with aerobic exercise showing the strongest comparative effect on stress, though heterogeneity was substantial [10]. Effect sizes vary with intervention design and comparator conditions [11].

Physiotherapy offers a non-pharmacological, low-cost approach through therapeutic exercise, stretching, posture correction, breathing and relaxation techniques and lifestyle education. However, few studies have examined its combined effect on physical fitness and stress in college students. Before such interventions can be designed and evaluated, the current fitness and stress profile of students needs to be described. This cross-sectional observational study therefore assessed physical fitness and psychological stress in a sample of college students, compared stress across domains and by sex, and examined fitness–stress associations.

2. Methods

2.1 Study design and participants

This cross-sectional observational study was conducted among BPT students using convenience sampling and followed STROBE guidelines [12]. Participants were assessed once without intervention. The dataset included 52 students with fitness measurements and 51 with complete stress scores. Eligibility criteria included mild-to-moderate stress and reduced physical activity, with relevant medical conditions and recent surgery/fracture excluded. Sample-size

determination, ethical approval details, and written informed consent should be reported.

2.2 Outcome Measures

Height and weight were measured, and BMI was calculated as weight (kg)/height² (m²) and classified using WHO cut-offs [13]. Flexibility was assessed using the sit-and-reach test [14], while muscular endurance was assessed using a timed repetition test [exact test and scoring to be confirmed]. Psychological stress was measured using the 40-item Student Stress Inventory (SSI), covering physical, interpersonal, academic, and environmental domains [15,16]. Items were scored from 1–4, with total scores ranging from 40–160; higher scores indicated greater stress. Each domain comprised 10 items (10–40). Missing responses (0.9%) were handled by prorating domain scores.

2.3 Statistical Analysis

Data were analysed using Python (SciPy). Continuous variables were expressed as mean $\pm$ SD, with stress scores additionally reported as median (IQR), and categorical variables as frequency (%). Normality was assessed using the Shapiro–Wilk test. Stress domains were compared using repeated-measures ANOVA with partial η^2 , supported by the Friedman test and Bonferroni-adjusted paired t-tests. Sex differences were assessed using Welch's t-test and Mann–Whitney U test, with Cohen's d and 95% CIs reported. Associations were examined using Pearson's r and Spearman's ρ , with Holm adjustment for multiple fitness–stress correlations. Internal consistency was assessed using Cronbach's α . Analyses used 51 participants for total stress and 50 for fitness–stress correlations due to missing data. Statistical significance was set at two-tailed $p < 0.05$.

3. Results

Fifty-two students completed the physical fitness assessment, and 51 of them have complete scores on the 40-item Student Stress Inventory (SSI). The results describe this group and should be generalised to the wider student population with caution. Data are summarised as mean $\pm$ standard deviation and analysed with standard parametric tests (independent-samples Welch t-test, repeated-measures ANOVA, paired t-test, Pearson correlation), with non-parametric checks where stated; $p < 0.05$ is taken as statistically significant.

3.1 Sociodemographic profile

Table 1: Sociodemographic characteristics of participants (n = 52)

Characteristic	Category	n (%)
Age group (years)	17–18	13 (25.0%)
	19–20	17 (32.7%)
	21–22	8 (15.4%)
	23–2	14 (26.9%)
Sex	Male	11 (21.2%)
	Female	41 (78.8%)
Course	BPT (Bachelor of Physiotherapy)	52 (100.0%)

Figure 1: Distribution of participants by sex and age group (n = 52).

Interpretation

The 52 participants were aged 17 to 25 years (mean 20.5 ± 2.2) and all were BPT students. The sample was predominantly female (41 of 52, 78.8%), with only 11 men, so any comparison by sex is underpowered and can only be treated as indicative [21]. Ages were spread across the four bands (15–33% each), the largest being 19–20 years (32.7%).

3.2 Descriptive analysis of stress scores

Table 2: Descriptive statistics of stress domain scores

Variable	n	Mean $\pm$ SD	Median (IQR)	Range	95% CI of mean
Physical stress (/40)	52	20.9 ± 6.3	21.0 (17.0–24.3)	10–37	19.2–22.7
Interpersonal stress (/40)	51	18.9 ± 6.0	19.0 (15.0–22.5)	10–32	17.2–20.6
Academic stress (/40)	52	20.4 ± 6.5	20.5 (16.0–24.0)	10–36	18.6–22.2
Environmental stress (/40)	52	24.6 ± 6.5	25.0 (21.0–29.0)	10–37	22.8–26.4
Total stress (/160)	51	85.2 ± 19.6	86.0 (73.0–94.0)	42–127	79.7–90.7

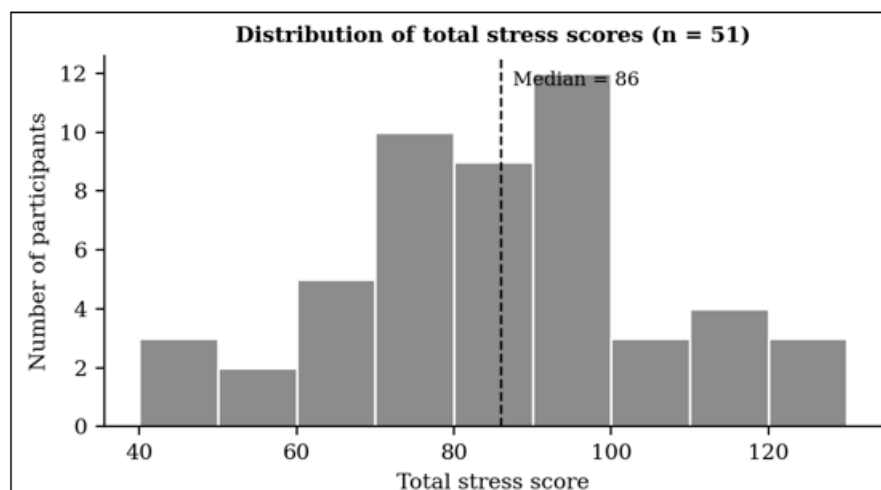


Figure 2: Distribution of total stress scores (n = 51)

Interpretation

The mean total stress score was $85.2 \pm 19.6/160$, indicating moderate stress. Environmental stress was the highest domain, followed by physical, academic, and interpersonal

stress. Total stress scores ranged from 42–127, indicating substantial individual variation. The SSI demonstrated excellent internal consistency (Cronbach's $\alpha = 0.91$) [20].

Table 3: Normality of the stress scores (Shapiro–Wilk test)

Variable	W	p-value	Conclusion
Physical stress	0.963	0.111	No evidence of non-normality
Interpersonal stress	0.96	0.085	No evidence of non-normality
Academic stress	0.959	0.074	No evidence of non-normality
Environmental stress	0.961	0.085	No evidence of non-normality
Total stress	0.982	0.648	No evidence of non-normality

Interpretation

None of the domain scores or the total departed from a normal distribution (all $p > 0.05$), so mean $\pm$ SD and parametric tests are appropriate. Welch's t-test is used for the sex comparison because the groups are very unequal (11 men, 41 women) [17].

Because every student answered all four domains, the domains were compared with a repeated-measures ANOVA ($n = 51$). Domain scores differed significantly, $F(3, 150) = 15.51$, $p < 0.001$, partial $\eta^2 = 0.24$ (large effect); the Friedman test agreed ($\chi^2(3) = 35.6$, $p < 0.001$). Pairwise results are in Table 4.

3.3 Comparison of stress domains**Table 4:** Pairwise domain comparisons (paired t-test, $n = 51$)

Comparison	Mean difference	t	Raw p	Bonferroni-adjusted p	d
Physical vs Interpersonal	1.98	2.15	0.036	0.218	0.3
Physical vs Academic	0.29	0.29	0.775	1	0.04
Physical vs Environmental	-3.92	-3.78	<0.001	0.003	-0.53
Interpersonal vs Academic	-1.69	-2.28	0.027	0.161	-0.32
Interpersonal vs Environmental	-5.90	-7.11	<0.001	<0.001	-1.00
Academic vs Environmental	-4.22	-5.36	<0.001	<0.001	-0.75

Interpretation

Environmental stress was significantly higher than each of the other three domains after Bonferroni correction (differences of 3.9 to 5.9 points; $d = 0.53$ to 1.00). Physical, interpersonal and academic stress did not differ from one another once the six comparisons were adjusted. Campus and surroundings

(noise, crowding, facilities and living conditions) are therefore the main source of strain in this group, which is similar to the high environmental stress reported by female physiotherapy students in Thailand [22].

3.4 Comparative analysis by sex**Table 5:** Comparison of stress scores by sex (independent-samples Welch t-test)

Score	Male ($n=11$) Mean $\pm$ SD	Female ($n=40$) Mean $\pm$ SD	Difference F–M (95% CI)	t	p	p (M–W)	Cohen's d
Physical stress	20.62 $\pm$ 6.77	21.15 $\pm$ 5.66	0.5 (–4.2, 5.3)	0.24	0.815	0.982	0.09
Interpersonal stress	18.67 $\pm$ 6.63	16.47 $\pm$ 4.78	–2.2 (–6.8, 2.4)	–1.03	0.322	0.29	0.42
Academic stress	23.64 $\pm$ 7.27	21.77 $\pm$ 7.53	–1.9 (–7.1, 3.4)	–0.75	0.464	0.281	0.25
Environmental stress	23.18 $\pm$ 7.05	24.34 $\pm$ 6.49	1.2 (–3.9, 6.2)	0.49	0.63	0.39	0.18
Total stress	86.01 $\pm$ 24.24	83.77 $\pm$ 20.27	–2.2 (–19.3, 14.9)	–0.28	0.783	0.59	0.11

Effect size $d =$ absolute Cohen's d (0.2 small, 0.5 medium, 0.8 large) [18]. $M-W =$ Mann–Whitney U test. No comparison reached $p < 0.05$. [Author note: this table used the 10/9/11/10 item allocation for the four domains, whereas Table 2 uses ten items per domain, so domain means differ slightly (e.g., interpersonal 16.9 vs 18.9). Confirm one allocation against the SSI manual and re-run all tables so they agree.]

analytic finding that females report more stress than males [8], but the study cannot confirm any sex difference; these patterns are best treated as hypotheses for a larger sample.

Interpretation

Men and women did not differ in total stress (86.0 vs 83.8; $t = -0.28$, $p = 0.783$) or in any domain (all $p \geq 0.29$). The largest effect, for interpersonal stress ($d = 0.42$, men higher), rests on only 11 men and the confidence intervals are wide, so a real difference of several points cannot be excluded [21]. The absence of a sex difference contrasts with the Indian meta-

3.5 Correlation analysis

Table 6: Correlation between stress domains and total stress (n = 51)

Variable 1	Variable 2	Pearson r	p	Spearman ρ	p
Physical stress	Interpersonal stress	0.43	0.002	0.45	<0.001
Physical stress	Academic stress	0.34	0.015	0.42	0.002
Physical stress	Environmental stress	0.32	0.024	0.29	0.039
Interpersonal stress	Academic stress	0.64	<0.001	0.68	<0.001
Interpersonal stress	Environmental stress	0.54	<0.001	0.51	<0.001
Academic stress	Environmental stress	0.61	<0.001	0.56	<0.001
Physical stress	Total stress	0.67	<0.001	0.65	<0.001
Interpersonal stress	Total stress	0.83	<0.001	0.84	<0.001
Academic stress	Total stress	0.83	<0.001	0.86	<0.001
Environmental stress	Total stress	0.79	<0.001	0.73	<0.001

Interpretation

All six pairs of domains were positively and significantly correlated ($r = 0.32$ to 0.64), from moderate (physical with environmental, $r = 0.32$) to strong (interpersonal with academic, $r = 0.64$), and Pearson and Spearman agreed throughout. Students who reported stress in one area therefore tended to report it in the others, consistent with a general stress tendency measured by the SSI [15,16]. The weakest links (physical with environmental and with academic, $p = 0.024$ and 0.015) would not survive a strict Bonferroni threshold of 0.008 . Each domain is part of the

total, so the correlations with total stress (0.67 to 0.83) are partly built in and should not be read as independent findings.

3.6 Physical fitness profile

Height, weight, BMI, flexibility (sit-and-reach, which has only moderate validity for hamstring extensibility [14]) and muscular endurance were recorded for 52 participants (41 women, 11 men; age 17–25 years). The same parametric approach used above is applied.

Table 7: Descriptive statistics of physical fitness measures (n = 52)

Variable	Mean $\pm$ SD	Distribution
Age (years)	20.46 $\pm$ 2.23	Departs from normality
Height (cm)	158.90 $\pm$ 7.00	Departs from normality
Weight (kg)	57.22 $\pm$ 11.41	No evidence of non-normality
BMI (kg/m ²)	22.72 $\pm$ 4.64	No evidence of non-normality
Flexibility (cm)	46.10 $\pm$ 10.62	No evidence of non-normality
Endurance (score)	57.13 $\pm$ 24.69	Strongly non-normal (two outliers of 150)

Table 8: Distribution of participants by BMI category (WHO cut-offs, n = 52)

BMI category	BMI (kg/m ²)	n (%)
Underweight	< 18.5	10 (19.2%)
Normal	18.5 – 24.9	30 (57.7%)
Overweight	25.0 – 29.9	7 (13.5%)
Obese	≥ 30.0	5 (9.6%)
Asian action point (increased risk)	≥ 23.0	21 (40.4%)
Asian action point (high risk)	≥ 27.5	8 (15.4%)

Interpretation

Mean BMI was 22.7 kg/m^2 (normal range), but only 30 of 52 students (57.7%) had a normal BMI: 10 (19.2%) were underweight and 12 (23.1%) were overweight or obese. Using the Asian action point of 23.0 kg/m^2 , 40.4% had raised risk [13]. The sample therefore carries a double burden of

under- and over-nutrition, as also reported in Indian college students [23]. Endurance was strongly right-skewed: two students recorded 150, far above the rest, so the mean (57.1) is inflated and the median would be the more representative summary.

Table 9: Comparison of fitness measures by sex (independent-samples Welch t-test)

Measure	Male (n=11) Mean $\pm$ SD	Female (n=41) Mean $\pm$ SD	Difference F–M (95% CI)	t	p	p (M–W)	Cohen's d
Age (years)	20.64 $\pm$ 2.66	20.41 $\pm$ 2.13	–0.2 (–2.1, 1.6)	–0.26	0.802	0.892	0.1
Height (cm)	159.18 $\pm$ 5.58	158.83 $\pm$ 7.40	–0.4 (–4.6, 3.9)	–0.17	0.865	0.857	0.05
Weight (kg)	63.96 $\pm$ 12.20	55.41 $\pm$ 10.62	–8.6 (–17.2, 0.1)	–2.12	0.052	0.027	0.78
BMI (kg/m ²)	25.43 $\pm$ 5.50	22.00 $\pm$ 4.17	–3.4 (–7.3, 0.4)	–1.92	0.076	0.043	0.77
Flexibility (cm)	44.91 $\pm$ 12.57	46.41 $\pm$ 10.19	1.5 (–7.3, 10.3)	0.37	0.72	0.645	0.14
Endurance (score)	60.64 $\pm$ 31.87	56.20 $\pm$ 22.78	–4.4 (–26.6, 17.7)	–0.43	0.672	1	0.18

M–W = Mann–Whitney U test; d = absolute Cohen's d.

Interpretation

Men were heavier (by 8.6 kg) and had a higher BMI (by 3.4 kg/m²), with medium-to-large effects ($d \approx 0.8$) [18]. The Welch t-test was borderline ($p = 0.052$ and 0.076) while the

Mann–Whitney test was significant ($p = 0.027$ and 0.043), so this finding is suggestive but not firm, particularly with only 11 men [21]. Age, height, flexibility and endurance did not differ by sex (all $p > 0.64$).

Table 10: Correlation between fitness measures and stress scores ($n = 50$)

Fitness measure	Stress score	Pearson r	p	Holm-adjusted p	Spearman ρ	p
Flexibility	Physical	-0.00	0.989	1	0.04	0.789
Flexibility	Interpersonal	0.25	0.082	1	0.24	0.096
Flexibility	Academic	0.23	0.116	1	0.26	0.072
Flexibility	Environmental	0.31	0.028	0.42	0.24	0.092
Flexibility	Total stress	0.24	0.09	1	0.23	0.108
Endurance	Physical	0.23	0.112	1	0.25	0.081
Endurance	Interpersonal	0.21	0.152	1	0.2	0.157
Endurance	Academic	0.12	0.416	1	0.15	0.291
Endurance	Environmental	0.16	0.274	1	0.07	0.618
Endurance	Total stress	0.21	0.151	1	0.19	0.18
BMI	Physical	0.07	0.627	1	0.03	0.811
BMI	Interpersonal	0.04	0.759	1	0.04	0.787
BMI	Academic	0.11	0.467	1	0.1	0.504
BMI	Environmental	-0.04	0.801	1	-0.07	0.607
BMI	Total stress	0.06	0.695	1	0.03	0.822

Interpretation

Only one of 15 correlations was initially significant: flexibility with environmental stress ($r = 0.31$, 95% CI 0.03–0.54, $p = 0.028$). However, it was not supported by Spearman correlation ($\rho = 0.24$, $p = 0.092$) and lost significance after Holm adjustment ($p = 0.42$) [19]. Overall, flexibility, endurance, and BMI showed no significant association with stress. These findings are consistent with previous research showing no association between flexibility and stress in physiotherapy students [22].

4. Discussion

In this cross-sectional study of 52 physiotherapy students, overall stress was moderate, with environmental stress being the highest domain. Stress domains were strongly correlated, while no significant sex difference in stress was observed. Only 57.7% of students had a normal BMI, indicating a substantial prevalence of both underweight and overweight/obesity [13,23].

The moderate stress levels are consistent with previous reports of substantial stress among students [6–8]. The prominence of environmental stress suggests that factors such as noise, crowding, facilities and living conditions may contribute to student stress and may require attention beyond exercise-based approaches [22]. The high internal consistency of the SSI ($\alpha = 0.91$) and correlations among domains suggest an overall tendency toward stress [15,16].

No meaningful associations were found between BMI, flexibility, endurance and stress. The single nominal flexibility–environmental stress correlation was not confirmed by Spearman analysis or Holm adjustment and was therefore considered likely to be a chance finding [19]. Previous studies have reported associations between stress and other fitness measures [22,24], but fitness measures may not fully represent habitual physical activity [25].

Because the study was observational and cross-sectional, causal relationships between fitness, physical activity and

stress cannot be established. Existing evidence suggests that exercise programmes may reduce university-student stress, particularly when continued for longer periods [9–11]. These findings provide useful reference data for future intervention studies.

5. Limitations

The cross-sectional design prevents causal inference. The small, single-centre convenience sample, predominantly female (79%), limits generalisability and sex-comparison power [21]. Self-reported stress, limited fitness measures, and the sit-and-reach test's measurement limitations [14] may affect findings. Multiple correlations required Holm adjustment to reduce false-positive results [19]. Missing data and unverified endurance outliers further limited the analyses.

6. Future recommendations

Future studies should use larger, sex-balanced, multi-centre samples with prior sample-size calculation [21]. Include validated physical-activity questionnaires and cardiorespiratory fitness measures [22,25]. Longitudinal studies and randomised trials should evaluate physiotherapy exercise programmes for stress reduction [9–11]. Colleges should screen BMI using appropriate Asian cut-offs and address environmental stressors [13,23]. Data linkage, STROBE reporting, confidence intervals and multiplicity adjustment should be ensured [12,19].

7. Strengths

The study assessed physical fitness and psychological stress in the same student group, using objective BMI measurements with WHO and Asian-specific classifications [13]. The SSI provided a detailed four-domain assessment with high internal consistency ($\alpha = 0.91$) [15]. Appropriate statistical tests, effect sizes, confidence intervals and multiple-comparison correction strengthened the analysis [18,19]. Missing data were addressed, and reporting followed

STROBE guidelines [12]. The findings provide reference data for future intervention studies.

8. Conclusion

Physiotherapy students in this sample showed moderate psychological stress, greatest in the environmental domain, and a substantial proportion had abnormal BMI, while fitness and stress were largely unrelated. Larger, more balanced samples and longitudinal or controlled studies are needed to clarify whether physiotherapy-based exercise programmes can improve fitness and reduce stress in students.

References

- [1] World Health Organization. Physical activity. WHO Fact Sheet; 26 June 2024.
- [2] Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Health*. 2018;6(10):e1077–e1086.
- [3] Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child Adolesc Health*. 2020;4(1):23–35.
- [4] World Health Organization. Physical Activity Profile 2024: India. Geneva: WHO; 2024.
- [5] World Health Organization. WHO Guidelines on Physical Activity and Sedentary Behaviour. Geneva: WHO; 2020.
- [6] World Health Organization. Mental health of adolescents. 1 September 2025.
- [7] World Health Organization. Adolescent and young adult health. 26 November 2024.
- [8] Kaur H, Gupta V, Garg A, Sangeeta, Padhi BK. Prevalence of depression, anxiety, stress and suicide ideation among undergraduate medical students in India: a systematic review and meta-analysis. *Natl J Community Med*. 2024;15(10). doi:10.55489/njcm.151020244529
- [9] Liu L, Xin X, Wang H, Zhang Y. Effectiveness of physical exercise on mental health among university students: a systematic review and meta-analysis. *Front Psychol*. 2025; 16:1612408. doi:10.3389/fpsyg.2025.1612408
- [10] Zhao Z, Li T, Lai H, Yang R. Comparative effects of exercise modalities on depression, anxiety, and stress in university students: a systematic review and network meta-analysis of randomized controlled trials. *Front Public Health*. 2026; 14:1795525. doi:10.3389/fpubh.2026.1795525
- [11] Huang K, Beckman EM, Ng N, Dingle GA, Han R, James K, et al. Effectiveness of physical activity interventions on undergraduate students' mental health: systematic review and meta-analysis. *Health Promot Int*. 2024;39: daae054. doi:10.1093/heapro/daae054
- [12] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453–1457. doi:10.1016/S0140-6736(07)61602-X
- [13] WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157–163. doi:10.1016/S0140-6736(03)15268-3
- [14] Mayorga-Vega D, Merino-Marban R, Viciano J. Criterion-related validity of sit-and-reach tests for estimating hamstring and lumbar extensibility: a meta-analysis. *J Sports Sci Med*. 2014;13(1):1–14.
- [15] Arip MASM, et al. Manual of the Student Stress Inventory (SSI): development, validity and reliability. 2016. [verify full author list, publisher and year before submission]
- [16] Yaghubi H, Noori S, Abbasi R. Investigating the psychometric properties (validity and reliability) of the Student Stress Questionnaire (SSI). *J Clin Psychol Pers*. [verify year, volume and pages]
- [17] Delacre M, Lakens D, Leys C. Why psychologists should by default use Welch's t-test instead of Student's t-test. *Int Rev Soc Psychol*. 2017;30(1):92–101. doi:10.5334/irsp.82
- [18] Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
- [19] Holm S. A simple sequentially rejective multiple test procedure. *Scand J Stat*. 1979;6(2):65–70.
- [20] Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ*. 2011; 2:53–55. doi:10.5116/ijme.4dfb.8dfd
- [21] Button KS, Ioannidis JPA, Mokrysz C, Nosek BA, Flint J, Robinson ESJ, Munafò MR. Power failure: why small sample size undermines the reliability of neuroscience. *Nat Rev Neurosci*. 2013;14(5):365–376. doi:10.1038/nrn3475
- [22] Suwannakul B, Sangkarit N, Manoy P, Amput P, Tapanya W. Association between stress and physical fitness of university students' post-COVID-19 pandemic. *J Funct Morphol Kinesiol*. 2023;8(1):33. doi:10.3390/jfmk8010033
- [23] Talati KN, Parmar A, Zalavadiya D, Shinde M, Madan-Patel G. Epidemiological insights into anthropometric indices and their correlates among college students through a university-level screening program in Western India. *Indian J Community Med*. 2022;47(3):445–448. doi:10.4103/ijcm.ijcm_1219_21
- [24] Kettunen O, Kyröläinen H, Santtila M, Vuorimaa T, Vasankari TJ. Greater levels of cardiorespiratory and muscular fitness are associated with low stress and high mental resources in normal but not overweight men. *BMC Public Health*. 2016; 16:788. doi:10.1186/s12889-016-3470-6
- [25] Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. 1985;100(2):126–131.
- [26] Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. *Sports Med*. 2014;44(1):81–121. doi:10.1007/s40279-013-0090-5