eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

Physical Activity, Sedentary Behaviour, Sleep Quality, and Psychological Well-being among Female College Students: A Narrative Review of Current Evidence

Dr Priyanka Singh[1]
[1]Assistant Professor, Department of Physical Education, A.N.D.N.N.M.M., Harsh Nagar, Kanpur Affiliated to C.S.J.M. University, Kanpur, U.P.

Received: 20 Jan 2026, Accepted: 25 Jan 2026, Published with Peer Reviewed on line: 31 Jan 2026

Abstract

The stage of higher education is a decisive developmental transition in the lives of young women. During the same period, habits related to physical activity, sedentary behavior, sleep quality, and psychological well-being are stabilized in the long term. In the present narrative review, the interrelationships of these four concepts have been synthesized in the context of female college students under the 24-hour movement behaviour framework. For the literature collection, a Boolean search strategy was adopted for the period 2015 to 2026 on PubMed/MEDLINE, Google Scholar, ScienceDirect, SpringerLink and EBSCOhost/PsycINFO, and the quality-evaluation of the selected material was done on the criteria of SANRA (Scale for the Assessment of Narrative Review Articles). According to synthesized evidence, the prevalence of inadequate physical activity among university students is approximately eight percentage-point higher than that of men globally (Guthold et al., 2018). Device-based measurements show that students spend an average of about 9.8 hours of sedentary activity per day (Castro et al., 2020). The prevalence of poor sleep quality has ranged from 26% to 70% in different regional groups (Mahmoud et al., 2026; Whitehead & Horton, 2025; Zhang et al., 2026). Intervention-based evidence confirms that the exercise employed has a meaningful impact on students' overall mental health (SMD = 0.91), well-being (SMD = 0.41), anxiety (SMD = −0.62), depression (SMD = −0.67) and perceived stress (SMD = −0.46) (Liu et al., 2025). Is temporal substitution also reveals that replacing sedentary time with moderate or intense physical activity leads to quantitatively improved sleep quality and symptoms of anxiety and depression (Barbosa et al., 2025; Menezes-Júnior et al., 2024). The review concludes that student health interventions should be based on a gender-sensitive and holistic 24-hour approach rather than a single-behaviour approach.

Keywords: physical activity; sedentary behaviour; sleep quality; psychological well-being; female college students; 24-hour movement behaviour; narrative review

Introduction

1.1 Health Transition and the Emerging Behavioural Risk Profile of Young Adults

The global disease burden pattern has fundamentally changed over the last three decades. The leading causes of death and disability are no longer infectious diseases, but non-communicable diseases, which often have their roots in behavioural patterns of adolescence and adolescence. Four pillars of this risk profile have been identified: inadequate physical activity, chronic immobility, inadequate and fragmented sleep, and chronic psychosocial stress. The World Health Organization's 2020 guidelines recommend 150 to 300 minutes of moderate-intensity or 75 to 150 minutes of high-intensity aerobic activity per week for adults and also make it clear that keeping sedentary time to a minimum is itself an independent health goal (Bull et al., 2020; World Health Organization, 2020). The ground situation is different. According to a consolidated analysis of 358 population-based surveys from 168 countries and 1.9 million participants, 27.5% of adults globally were insufficiently active in 2016, and the rate remained almost constant between 2001 and 2016.

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

1.2 The College Years as a Critical Developmental Window

In developmental psychology, the period of 18 to 25 years is called "emerging adulthood", the stage in which a person steps out of family supervision to make independent decisions about food, sleep, activity, and time-management for the first time. Qualitative research on Australian university students revealed that students' physical activity, diet, sleep, and mental well-being decline simultaneously upon admission to university, which students themselves attribute to lack of time, new social structures, and academic pressures (Oftedal et al., 2023). Since the sleep cycle, screen-use and exercise patterns established in emerging adulthood determine the direction of the health trajectory leading up to middle adulthood, this period is considered the "window of opportunity" with the highest returns in terms of intervention.

1.3 Why Female College Students Require Separate Attention

There are at least four strong grounds for treating female students as a separate study group. The first is epidemiological: the global prevalence of insufficient physical activity is consistently higher in women than in men (Guthold et al., 2018). The second is biological: hormonal fluctuations associated with the menstrual cycle directly affect sleep architecture, core body temperature and mood (Baker & Driver, 2007), and pain caused by dysmenorrhea becomes a recurring cause of activity avoidance that hardens into habit over time. The third is psychological: female students in large multi-university samples reported higher rates of sleep problems and mental-health symptoms (Becker et al., 2018). The fourth is socio-cultural: the male-dominated environment of campus gymnasiums, dress discomfort, safety concerns, and family expectations create specific barriers for female students that are absent from male students' experience (Kanaan et al., 2023; Wilson et al., 2022). In settings such as India, where female students in rural and semi-urban areas also carry domestic responsibilities, these barriers intensify.

1.4 The 24-Hour Movement Behaviour Framework: Activity, Sitting and Sleep as an Interdependent System

Traditional health research has studied physical activity, sedentary behaviour, and sleep separately. This division ignores a fundamental mathematical fact: there are only 24 hours in a day, and the sum of these three behaviours is always equal to these 1,440 minutes, so an increase in one is possible only at the expense of another. This insight is the basis of the 24-Hour Movement Behaviour Framework, formalized by Canada's guidelines for the 18-64 age group (Ross et al., 2020). Its practical power is manifested in isotemporal substitution analysis, which quantitatively assesses how much health outcomes change when a segment of sedentary time is replaced by sleep or activity. The health impact of a 30-minute increase in MVPA therefore depends on where those 30 minutes were taken. Within this framework psychological well-being is located not as a fourth behavioural component but as an outcome domain, and the relationship is not unidirectional since stress and depression are themselves strong precursors of activity deficits and sleep disruption. The structure is of particular importance for female students, whose 24 hours are divided not only into academic and leisure activities but also into household labour, caregiving responsibilities, and movement-related safety restrictions.

1.5 Rationale, Research Questions and Objectives of the Review

1.5.1 Rationale

There is a vast independent literature on physical activity, immobility, sleep, and mental health, but an integrated synthesis of the interrelationships of these four, especially in the context of female college students, is relatively sparse; Most of the available reviews are either gender-aggregated or focus only on a pair of two variables. On the other hand, the availability of organized academic synthesis on the subject in the Hindi

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

language is extremely limited, which restricts access to evidence-based content for teachers and researchers of Indian physical education and health sciences. This review attempts to address this double gap.

1.5.2 Research Questions

The presented review is guided by the following four research questions:

4. What is the current prevalence pattern of physical activity, sedentary behaviour, sleep quality, and psychological well-being among female college students, and what regional and cultural differences are observed?
5. What kind of directional, mediating, and moderating relationships between these four concepts are supported by evidence?
6. Which biological, psychological, socio-cultural, and institutional factors act as a deterrent or facilitator of these behaviours of girl students?
7. What kind of gender-sensitive interventions and policy recommendations can be implemented at the collegiate level from the available evidence?

1.5.3 Objectives of the Review

The objectives of the review have been set out as follows: (a) To present a thematic synthesis of contemporary epidemiological evidence of the four concepts; (b) To theoretically map the interrelationships of these concepts within the 24-hour dynamic-behaviour framework; (c) To critically evaluate the strengths and limitations of measurement methods; (d) To identify existing research gaps in the literature; and (e) To present implementable recommendations at the institutional and policy level.

1.6 Operational Definitions of Key Constructs

1. Physical Activity (PA): any bodily movement produced by skeletal muscles that expends more energy than rest. By intensity it is classified as light (LPA), moderate and vigorous, the last two collectively termed MVPA, and is expressed quantitatively in MET-minutes per week (Craig et al., 2003; World Health Organization, 2020). 2. Sedentary Behaviour (SB): according to the consensus terminology of the Sedentary Behaviour Research Network, any waking behaviour in a sitting, reclining, or lying posture with energy expenditure of 1.5 MET or less (Tremblay et al., 2017). This establishes a clear distinction between inactivity, meaning non-fulfilment of guidelines, and immobility, meaning time spent sitting: a student may be highly sedentary even while exercising daily. 3. Sleep Quality (SQ): a multidimensional construct comprising subjective satisfaction, latency, duration, efficiency, disturbance, medication use, and daytime dysfunction (Buysse et al., 1989); contemporary sleep science places it under the broader concept of sleep health (Buysse, 2014).

4. Psychological Well-being (PWB): under the bi-continuum paradigm, well-being is not merely the absence of mental disorder but the positive presence of emotional, psychological, and social well-being (Keyes, 2002). The present review therefore includes both negative indicators (stress, anxiety, depression) and positive indicators (life satisfaction, self-esteem, resilience, flourishing) (Diener et al., 2010; Rosenberg, 1965).

2. Methodology of the Narrative Review

2.1 Review Design and Justification for a Narrative Approach

The present study is designed as a comprehensive narrative review. The choice of this approach is determined by the nature of the content. When the research question is limited to the impact assessment of a single and well-defined intervention, systematic review and meta-analysis are the best methodology. But where the objective is a theoretical mapping of the complex, multidirectional, and culturally contextual relationships between the four interdependent behavioural concepts, narrative synthesis is more appropriate, as it gives the

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

flexibility to condense quantitative, qualitative and mixed-methodological studies into a single conceptual framework.

2.2 Databases and Information Sources Searched

The following electronic databases were used for a systematic search of the literature: PubMed/MEDLINE, Google Scholar, ScienceDirect, SpringerLink and EBSCOhost/PsycINFO. Backward citation chaining of the bibliography of selected articles was also done, and technical reports from the World Health Organization and national health bodies were included as grey literature.

2.3 Search Terms and Search Strategy

The search strategy was based on Boolean operators (AND, OR), combining synonyms for all four concepts: ("Physical Activity" OR "Exercise" OR "Movement") AND ("Sedentary Behaviour" OR "Screen Time" OR "Sitting") AND ("Sleep Quality" OR "Sleep Duration" OR "Sleep Architecture") AND ("Psychological Well-being" OR "Stress" OR "Anxiety" OR "Depression") AND ("Female College Students" OR "University Women" OR "Young Adult Females") Each concept set was also conducted separately to increase the sensitivity of the search, and the MeSH terminology was used when it became available.

2.4 Inclusion and Exclusion Criteria

The criteria for selection of studies are given in Table 1.

Table 1. Inclusion and exclusion criteria applied in the review

Criteria Area	Inclusion Criteria	Exclusion Criteria
Population	Female college/university students aged 18–25 years; mixed-gender samples only when sex-stratified results were available	Clinically ill or pregnant populations; school students or employed adult samples
Content	Studies that analysed the interrelationship of any two or more variables among physical activity, sedentary behaviour, sleep, and mental health	Descriptive studies focused on only a single variable, without testing any interrelationship
Study Type	Peer-reviewed original research articles, systematic reviews, meta-analyses, and randomized controlled trials; valid technical guidelines	Conference abstracts only, editorials, letters to the editor, and articles for which full text was not available
Period	2015–2026; original source texts for measurement tools and theoretical models were acceptable even outside this range	Empirical studies published before 2015 that had no conceptual foundational value
Language	Articles published in English and Hindi	Articles published in other languages, due to the unavailability of translation resources

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

2.5 Period of Coverage and Study Selection Process

The primary coverage period of the review was set from 2015 to 2026 so that contemporary evidence could be represented adequately, particularly the behavioural changes that emerged after the COVID-19 pandemic. Original source texts for measurement instruments and theoretical models, such as Buysse et al. (1989), Radloff (1977), and Rosenberg (1965), were included even if they fell outside this time, because they constitute foundational conceptual material. The selection process was completed in three successive steps: first, the removal of duplicates after the database search; second, the determination of relevance based on title and summary; third, the final eligibility assessment based on full text.

2.6 Method of Synthesis and Thematic Organisation

The synthesis was carried out on a qualitative and thematic basis. From each selected study the following were extracted in structured form: author and year, country and context, sample size and sex composition, study design, measuring tools used (e.g., PSQI, IPAQ, GAD-7, PHQ-9), key findings and effect size. The findings were then grouped into six thematic categories: patterns and determinants of physical activity; sedentary behaviour and its consequences; sleep quality and circadian disruption; positive and negative indicators of psychological well-being; interrelationships among the concepts; and methodological issues of measurement.

2.7 Quality Appraisal Considerations (SANRA Criteria)

To ensure academic credibility, six SANRA criteria were followed: justification of the article's importance, a clear statement of objectives, description of the literature search, context-based argumentation, appropriate presentation of key concepts, and support of scientific statements by authentic data. Each cited statistic was matched to its original source, and data that could not be verified against the original source were excluded from the review.

3. Conceptual and Theoretical Framework

3.1 Biological and Neuroendocrine Pathways

The journey from behaviour to well-being passes through several biological pathways. Physical exercise regulates brain-derived neurotrophic factor (BDNF) and the monoamine neurotransmitters serotonin, dopamine, and norepinephrine, which form the primary biochemical basis of mood regulation. The second pathway is endocrine: regular exercise quenches hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis, reducing both baseline cortisol and its stress-responsiveness. A third, often neglected pathway is immuno-inflammatory; in an experimental study of college students, exercise reduced both depressive symptoms and inflammatory biomarkers, with moderate intensity producing the most favourable results (Paolucci et al., 2018). On the sleep side, the biological centre of circadian regulation is the suprachiasmatic nucleus, coordinated by optical as well as non-optical signals.

3.2 Psychological and Motivational Frameworks

The review presented to explain behavioural change is based on the Self-Determination Theory, according to which continuous motivation depends on the fulfilment of three basic psychological needs: autonomy, competence, and engagement (Ryan & Deci, 2000). When physical education is experienced as a compulsory, evaluated and comparative activity, autonomy is lost. If the student feels incapable due to a skill gap, then the need for competence remains unfulfilled. The male-dominated nature of the campus gymnasium gives rise to a lack of affiliation. The simultaneous inadequacy of all three needs is the strongest predictor of exercise abandonment.

3.3 The Socio-Ecological Layer: A Gendered Reading

These biological and psychological pathways operate in a socio-ecological environment that is different for female students. According to the socio-ecological paradigm, behaviour is determined at five levels, and

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

gender-specific barriers can be identified at each: body-image self-consciousness at the individual level, lack of family approval at the interpersonal level, male-dominated facilities at the institutional level, safety concerns in public spaces at the community level, and absence of gender-sensitive infrastructure standards at the policy level (Kanaan et al., 2023; Wilson et al., 2022). Targeted interventions at the individual level alone, such as motivational lectures or awareness campaigns, will produce limited effects if structural barriers at the institutional and community levels remain in place.

4. Physical Activity among Female College Students

4.1 Prevalence, Patterns and Guideline Adherence

A multicountry survey of 17,928 university students across 24 higher education institutions in 23 countries found an overall prevalence of physical inactivity to be 41.4%, meaning that two out of every five students do not even reach the recommended minimum level (Pengpid et al., 2015). The notable feature of this study is its vast inter-country variation, which ranges from 21.9% in Kyrgyzstan to 80.6% in Pakistan. Gender-based discrimination is further evident in population-level data: in a consolidated analysis of 168 countries, the prevalence of inadequate physical activity was recorded at 31.7% for women and 23.4% for men, and this gap remained stable between 2001 and 2016 (Guthold et al., 2018). In terms of pattern, evidence indicates that student activity is often erratic, fragmented, and low intensity. This cyclical pattern of full stops in exam periods and partial resumption during leisure periods appears to be a universal feature of university life (Oftedal et al., 2023).

4.2 Determinants and Psychosocial Correlates of Participation

Gender role orientation is a strong but often neglected determinant of female students' sports participation: in a study of Chinese college students categorised into bisexual, masculine, feminine and non-differentiated orientations, female students with a bisexual orientation were the most active and the non-differentiated category the least (Ma et al., 2025). Self-efficacy is a second dominant determinant. In a mediation analysis of 455 university students from five institutions in Yunnan province, physical fitness-related self-efficacy increased subjective well-being both directly and indirectly through physical activity, and this mediation effect was 23.66% among female students compared with only 11.93% among male students (Gao et al., 2025). The relationship with self-esteem also appears gender-differentiated: a study of Spanish university students (N = 314) found a meaningful relationship between physical activity and self-esteem, with the authors highlighting gender differences (Bermejo-Cantarero et al., 2025).

4.3 Physical Activity across the Menstrual Cycle

The menstrual cycle is an indispensable variable for understanding the activity regularity of female students, which is often completely ignored by normal epidemiological studies. Due to menstruation, pre-menstrual weakness and general discomfort, many students stop activity altogether during menstruation, creating a recurring activity break of four to seven days each month. Evidence supports the opposite strategy. In the Cochrane review of the effect of exercise on dysmenorrhea, which included a meta-analysis of data from 754 women, exercise produced a significant reduction in the intensity of monthly pain (SMD = −1.86; 95% CI: −2.06 to −1.66), although the authors ranked the quality of the evidence from low to very low (Armour et al., 2019). An updated network meta-analysis of 49 randomized controlled trials and 3,129 participants found resistance exercise to be most effective (MD = −5.2; SUCRA = 93.07%), followed by multi-component and mind-body exercise (MD = −3.5) (Zhao et al., 2024).

4.4 Barriers and Facilitators Reported in the Literature

Physiologically, symptoms associated with the menstrual cycle, namely pre-menstrual weakness, dysmenorrhea and hormonal imbalance, act as a direct barrier and make activity irregular (Baker & Driver,

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

2007). Lack of basic sports skills increases the risk of injury, most commonly ankle sprains and muscle spasms, and the effect is not merely physical: it triggers an avoidance response that places the student in a self-reinforcing cycle. Psychological barriers centre on body-image anxiety and low self-efficacy. The conflict between traditional cultural expectations and modern, cramped or revealing sports attire keeps many students away from public fitness sites, and unpleasant experiences of school physical education become long-term emotional memories that associate exercise with shame (Manalad et al., 2026; Roque et al., 2026). When programmes present short, sequential, and individually set goals, exercise transforms from an academic obligation into an active means of stress management.

At the sociocultural level, gender stereotypes characterise strength-based and competitive sports as "masculine" or "indecent," reducing female students' willingness to participate (Ma et al., 2025), and they receive less family encouragement than male classmates. In a qualitative study of Jordanian female students, time, facilities, religious-cultural norms, attitudes, and accessibility were identified as determinants of participation (Kanaan et al., 2023). On the facilitative side, same-sex sports communities, coach-guided novice groups, and strong companion networks significantly increase exercise continuity. Institutionally, the male-dominated environment of campus recreational facilities, especially weight-training areas, creates discomfort, and among American university students' women reported low levels of both facility use and perceived ease (Wilson et al., 2022), compounded by dilapidated or overcrowded facilities, harassment-related safety concerns and inadequate dissemination of information.

4.5 Measurement Approaches: Self-Report Instruments versus Device-Based Assessment

The most used self-report tool in university groups is the International Physical Activity Questionnaire (IPAQ), tested for reliability and validity in 12 countries (Craig et al., 2003). Such tools capture contextual information that no sensor can record: the type of activity, its domain, and its psychosocial environment. Their fundamental limitation is susceptibility to memory and social-desirability bias, since students over-report MVPA and under-report sitting time and screen exposure. Sensor-based measurement, including research-grade three-axis accelerometers, thigh-mounted inclinometers and consumer wearables, eliminates memory load, records the full 24-hour cycle, and is highly sensitive to light activity, which is often lost in self-report but is crucial for substituting sedentary time.

Disparities between protocols and data-processing algorithms make inter-study comparison difficult. Four technical parameters matter most: the wearing site, since wrist sensors overestimate activity while thigh sensors classify posture better but are less practical for long wear; the monitoring period and valid-wear criteria, under which a day is valid only with 8-12 hours of wear and at least 3-4 valid days are required; the epoch size, since 10-second epochs capture the intermittent movement of young adults that 60-second epochs flatten; and the intensity threshold, whose selection dramatically changes guideline-compliance classification on the same dataset. The comparative status of the two approaches is presented in Table 2.

Table 2. Comparison of self-report and device-based approaches to measuring physical activity and sedentary behaviour

Comparison Dimension	Subjective Self-Report	Objective Device-Based Assessment
Primary tools	IPAQ short and long forms, activity diaries, and screen-time questionnaires	Triaxial accelerometers worn on the wrist or waist, thigh-mounted inclinometers, and wearable smart devices

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

Information captured	Type of activity, domain such as leisure, transport, or domestic activity, and psychosocial context	Frequency, intensity, and duration of movement; posture classification; continuous 24-hour recording
Key strength	Low cost, practical for large-scale surveys, and rich contextual information	Free from recall burden, extremely sensitive to light activity, and highly reproducible
Key limitation	Recall bias and social-desirability bias; overestimation of MVPA and underestimation of sitting time	Limited contextual information; protocol heterogeneity including wear location, epoch length, and intensity cut-points; data loss during water-based activities
Empirical discrepancy	Pooled estimate: 7.29 hours/day of sedentary time (Castro et al., 2020)	Pooled estimate: 9.82 hours/day of sedentary time (Castro et al., 2020)
Recommended use	For estimating prevalence and understanding behavioural context	For verifying guideline adherence and precisely measuring intervention effects; integrated use of both approaches is optimal

5. Sedentary Behaviour in the College Population

5.1 Patterns, Volume and Accumulation of Sitting Time

Sedentary behaviour is a structural feature of college life, not an incidental deviation. A systematic meta-analysis of 125 studies found the pooled estimate of self-reported sedentary time among university students to be 7.29 hours per day, while the accelerometer-based estimate was 9.82 hours per day (Castro et al., 2020). The second figure is particularly important: if an average of seven hours of sleep is added to it, then nearly 17 of the 24 hours are spent in a motionless state, and all light, moderate, and vigorous activity is contained within the remaining seven hours. Another finding of the same meta-analysis concerns trend. Among the tested moderators, only publication year was significant, and meta-regression confirmed an increase in sedentary time over a ten-year period, indicating that this problem is not stable but progressively increasing.

The evidence regarding sex differences is nuanced. The above meta-analysis did not identify sex as a significant moderator; however, in a study of 253 college students from Guangdong Province, China, female students' sitting time was 11.24 ± 4.49 hours on weekdays and 11.95 ± 5.37 hours on weekends, which was slightly higher than that of male students (10.90 ± 4.78 and 11.77 ± 5.50 hours, respectively). The prevalence of prolonged sedentary behaviour (≥7 hours per day) was recorded as 83.20% among female students and 78.13% among male students (Tao et al., 2025).

5.2 Academic, Digital and Screen-Based Contributors

The three major sources of sedentary time among female students are classroom attendance, self-study and library work, and screen use during leisure time. The first two sources are academically unavoidable; the third is the area in which the real possibility of intervention lies. In a meta-analysis of 10 studies and 5,195 participants examining the relationship between smartphone dependence and sedentary behaviour, smartphone addiction was found to be associated with an almost twofold likelihood of low physical activity and sedentary behaviour (OR = 2.19; 95% CI: 1.34–3.57) (Nambirajan et al., 2025). Device-based evidence

further clarifies the nuance of this relationship. In a seven-day tracking study of university students, inactive students used smartphones for 384.31 ± 140.82 minutes per day, compared with 333.25 ± 121.55 minutes among active students ($p = 0.009$). The effect of application type was sex-differentiated, because among inactive female students, the use of social apps was found to be associated with reduced vigorous activity ($\beta = -0.012$, $p = 0.011$) (Shi et al., 2025).

5.3 Post-Pandemic Shifts in Sedentary Time and Online Learning

The COVID-19 pandemic created an unprecedented natural experiment in higher education. In a longitudinal study at a German university comparing a pre-pandemic survey from 2019 (N = 4,351) with a pandemic-period survey from 2020 (N = 3,066), sedentary time rose from 7.5 ± 2.6 to 8.9 ± 2.5 hours per day, an increase of 18.7%, with the greatest increase among students whose pre-pandemic sedentary time was below eight hours (Heller et al., 2023). Globally, a multilevel meta-analysis of 173 studies and 320,636 participants confirmed a moderate reduction in total physical activity during lockdown (SMD = −0.65) and a substantial increase in sedentary behaviour (SMD = 0.91) (Wilke et al., 2022). Given the permanent adoption of hybrid and online teaching, part of this pattern has plausibly become structurally embedded; for female students the specific implication is that reduced need to come to campus removes the light activity that is often their only regular source of movement.

5.4 Health Consequences Independent of Physical Activity

The most important conceptual feature of sedentary behaviour is that its health consequences are not fully explained by the level of physical activity. In a meta-analysis of 47 studies, even after statistical adjustment for physical activity, prolonged sedentary time was found to be associated with all-cause mortality (HR = 1.24; 95% CI: 1.09–1.41), cardiovascular mortality (HR = 1.18), cancer mortality (HR = 1.17), and the incidence of type 2 diabetes (HR = 1.91; 95% CI: 1.64–2.22) (Biswas et al., 2015). This finding received an important qualification when a harmonised meta-analysis of 16 prospective cohorts and more than one million participants demonstrated that approximately 60 to 75 minutes of moderate-intensity activity per day almost eliminated the mortality risk associated with prolonged sitting, whereas the risk remained markedly elevated among the least active groups; the notable exception was television viewing (Ekelund et al., 2016).

5.5 Sedentary Behaviour and Mental Health Outcomes

A meta-analysis of 12 prospective studies and 128,553 participants on the association between sedentary behaviour and mental health reported a pooled relative risk for depression of RR = 1.10 (95% CI: 1.03–1.19) (Huang et al., 2020). This effect size appears small in itself, but the real contribution of the study lies in its subgroup analysis, which established that all sedentary time is not equally harmful: television viewing was significantly associated with depression risk (RR = 1.18; 95% CI: 1.07–1.30), whereas computer use was not (RR = 0.99). Similarly, mentally passive sedentary behaviour increased risk (RR = 1.17), whereas mentally active sedentary behaviour was neutral (RR = 0.98). Therefore, the goal of intervention should not be an indiscriminate reduction of all sitting time, but the selective replacement of mentally passive and screen-based segments.

6. Sleep Quality among Female College Students

Sleep is a complex and finely regulated biological process that is indispensable for tissue repair, metabolic balance, cardiovascular health, neural restoration, and cognitive consolidation (Buysse, 2014).

6.1 Prevalence of Poor Sleep Quality and Insufficient Sleep Duration

When interpreting prevalence estimates of sleep quality, one methodological caution is essential: reported rates depend heavily on the PSQI cut-off used. Studies based on the standard PSQI > 5 cut-off report estimates between 26% and 31%, whereas studies using a > 7 cut-off or pandemic-period samples report rates above

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

60%. Data from China constitute the largest part of this picture. In an updated meta-analysis of 232 cross-sectional studies and 495,641 students, the pooled prevalence of sleep disturbance was found to be 26.4% (95% CI: 24.6–28.3), with a clear period-based trend: 24.1% before the pandemic, 33.5% during the pandemic, and 21.0% after the pandemic; no, statistically significant difference in prevalence was found by sex (Zhang et al., 2026). A study of 6,284 students in Jilin Province also pointed in the same direction. There, at PSQI > 5, 31.0% of students were classified as poor sleepers, and the overall prevalence did not differ significantly by sex, although female students had higher total PSQI scores and higher sleep-disturbance subcomponent scores (Li et al., 2020). In a pandemic-period survey of 6,363 students, where a higher cut-off was used, 63.28% of students were placed in the poor-sleep category (Yang et al., 2023).

Data from other regions further widen this variation. In an African meta-analysis of 35 studies and 16,275 university students, the pooled prevalence of poor sleep quality was found to be 63.31% (95% CI: 56.91–65.71) (Nakie et al., 2024). In assessments from the University of Lincoln in the United Kingdom (N = 486), 59% of female students and 57% of male students reported poor sleep at the PSQI ≥ 6 level, and the most concerning finding was that, across the whole group, only 18.1% of female students reported good sleep quality together with low levels of stress and depression (Whitehead & Horton, 2025). Among physical therapy students in Riyadh (N = 248), 70.6% were found to have poor sleep quality (Mahmoud et al., 2026), while among 456 female students at King Saud University, nearly 95% had a sleep duration of less than eight hours per day (Alzamil et al., 2019); among 8,059 undergraduate students in Brazil, this rate was 64.79% (Menezes-Júnior et al., 2024).

6.2 Sleep Architecture, Chronotype and Social Jetlag

The biological utility of sleep depends not only on its duration but on its internal architecture, comprising the NREM stages N1, N2 and N3 or slow-wave sleep, together with REM sleep. The irregular and stressful environment of college life is particularly associated with suppression of slow-wave and REM sleep; since the former is essential for physical and immunological restoration and the latter for memory consolidation and emotional regulation, their shortening directly affects the cognitive and emotional health of female students. The prevalence of an evening chronotype is higher in young university populations than at any other life stage, and when this tendency conflicts with morning timetables, circadian misalignment occurs, associated with mood disorders, emotional instability and reduced cognitive capacity (Baron & Reid, 2014). Its most common expression is “social jetlag”: female students obtain restricted sleep on weekdays and compensate through delayed weekend awakening, and this weekly oscillation repeatedly forces the central circadian pacemaker to readjust, disturbing melatonin and cortisol rhythms. A practical intervention point follows daytime physical activity acts as an effective non-photic zeitgeber, and human phase-response curves show that the timing of exercise determines whether the circadian phase advances or is delayed (Youngstedt et al., 2019). For female students with an evening chronotype, morning exercise is therefore a biologically targeted strategy, not merely general health advice.

6.3 Academic Demands, Examination Stress and Sleep Disruption

Academic demands disrupt female students’ sleep through two pathways. Physiologically, examination stress keeps the HPA axis and the sympathetic nervous system persistently activated, so cortisol and catecholamine levels remain elevated in the evening and sleep latency increases. Cognitively, pre-sleep rumination is central: when a student lies in bed repeatedly thinking about her performance and the possibility of failure, mental arousal remains high, delaying sleep onset and increasing wake after sleep onset (WASO). A systematic review and meta-analysis of sleep, insomnia symptoms and stress among undergraduates has confirmed the strength of this association (Gardani et al., 2022), which is most intense among female students in medical

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

and allied health sciences, where sleep disturbance and daytime dysfunction record the highest scores (Mahmoud et al., 2026).

6.4 Screen Exposure, Bedtime Procrastination and Sleep Hygiene

Use of electronic devices before bedtime is a major contemporary cause of poor sleep hygiene, operating at both biological and psychological levels. Biologically, short-wavelength blue light from screens stimulates intrinsically photosensitive retinal ganglion cells and suppresses melatonin secretion, delaying circadian rhythm and increasing sleep latency. Psychologically, bedtime procrastination becomes active: after a dense academic schedule, female students deliberately delay sleep to regain personal time and autonomy, which from the perspective of self-determination theory is a distorted attempt to compensate for the autonomy restricted throughout the day (Ryan & Deci, 2000). In a study of undergraduate female students, screen time was associated with emotional well-being, sleep quality, and menstrual symptoms, indicating that the influence of screen exposure is multisystemic rather than single pathway (Rizvi et al., 2026; Nambirajan et al., 2025).

6.5 Sex- and Gender-Specific Considerations in Sleep

At the biological level, hormonal changes associated with the menstrual cycle affect core body temperature, thermoregulatory response, and sleep architecture. The rise in progesterone during the luteal phase and its subsequent sharp decline directly disrupt sleep continuity, while pain caused by dysmenorrhea acts as an additional disturbing factor (Baker & Driver, 2007). At the social-gender level the evidence is more nuanced and in places counterintuitive. In a large multi-university sample, female students reported higher rates of sleep problems and mental-health correlates (Becker et al., 2018), yet in a survey of 6,363 Chinese students the adjusted association between poor sleep and psychological symptoms was significant among male students but not among female students (Yang et al., 2023), and two large meta-analyses found no significant sex difference in the overall prevalence of sleep disturbance (Li et al., 2020; Zhang et al., 2026). The most reasonable explanation is that sex differences are expressed not at the level of overall dichotomous prevalence rates but at the level of specific sleep components such as latency and disturbance, specific outcomes such as anxiety versus depression, and the structure of mediating pathways. The appropriate question for future research is therefore not "do female students sleep less," but "through which pathways is their sleep connected with their well-being."

6.6 Assessment Tools: PSQI, ESS, Actigraphy and Sleep Diaries

The Pittsburgh Sleep Quality Index (PSQI) is the most widely used and validated instrument globally; through 19 self-rated questions it assesses the previous month across seven components, each scored 0 to 3, producing a global score of 0-21 in which > 5 generally indicates poor sleep (Buysse et al., 1989). The Epworth Sleepiness Scale (ESS) assesses excessive daytime sleepiness (Johns, 1991), and sleep diaries reduce recall bias through real-time recording. On the objective side, actigraphy provides continuous movement-rest data over 7 to 14 days, while polysomnography remains the gold standard for measuring sleep stages. Contemporary epidemiology recommends combining subjective and objective instruments so that the behavioural context of sleep is captured along with its quantity. The comparative status of the instruments is presented in Table 3.

Table 3. Principal instruments used to assess sleep in student populations

Type	Instrument	Primary Measurement Parameters	Main Advantages	Limitations

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

Subjective	PSQI (Buysse et al., 1989)	Seven components; global sleep-quality score (0–21)	Low cost; highly practical for large surveys; widely validated	Recall bias; prevalence rates depend strongly on cut-off selection
Subjective	ESS (Johns, 1991)	Tendency toward sleepiness in eight daily situations	Accurate assessment of daytime cognitive fatigue	Measures only sleepiness, not sleep quality or architecture
Subjective	Sleep diary	Daily sleep-wake log; night-time disturbances	Real-time recording minimizes recall bias	Requires consistent compliance; high participant burden
Objective	Actigraphy	Movement-rest cycle, total sleep time, sleep latency	Continuous objective data for 7–14 days in a natural setting	May classify motionless wakefulness in bed as sleep; limited contextual information
Objective	Polysomnography (PSG)	Sleep architecture (N1, N2, N3, REM); EEG, EOG, EMG	Gold-standard measurement of sleep stages and biological parameters	Prohibitive cost; laboratory setting; impractical for large samples

7. Psychological Well-being among Female College Students

7.1 Prevalence of Stress, Anxiety and Depressive Symptoms in Higher Education

The period of university entry is developmentally extremely sensitive, and the prevalence of mental-health symptoms at this stage has been found to be concerningly high (Oftedal et al., 2023). In a large survey of 14,175 students across 26 campuses in the United States, the prevalence of depression was recorded as 17.3%, generalized anxiety as 7.0%, suicidal ideation as 6.3%, and non-suicidal self-injury as 15.3% (Eisenberg et al., 2013). In the United Kingdom study, moderate-to-severe anxiety on the GAD-7 was reported by 68% of female students and 49% of male students, while clinically significant depressive symptoms on the PHQ-8 were recorded among 73% of female students (Whitehead & Horton, 2025). In a survey of 6,363 university

students in China, the overall prevalence of psychological symptoms was 16.5%, with the rate among female students (17.7%) higher than that among male students (14.8%) (Yang et al., 2023). A study from a medical college in Saudi Arabia reported a high prevalence of stress, which was significantly higher among female students than male students (Abdulghani et al., 2011).

7.2 Positive Indicators: Life Satisfaction, Self-Esteem, Resilience and Flourishing

The construct of flourishing provides an integrated measure of positive social relationships, life purpose, optimism, and social competence (Diener et al., 2010). In a study of female physical-therapy students in Riyadh (N = 248), the flourishing score was 41.5 ± 8.9 and was negatively correlated with daytime dysfunction ($r = -0.409$) and global PSQI score ($r = -0.327$), meaning that better sleep quality was associated with greater flourishing (Mahmoud et al., 2026). Evidence on self-esteem and resilience is available from a study of Spanish university students (N = 1,469), in which adherence to the 24-hour movement guidelines—that is, MVPA, limited sedentary time, and adequate sleep—was associated with a significantly reduced likelihood of low self-esteem (AOR = 0.40; 95% CI: 0.23–0.71) and low resilience (AOR = 0.41; 95% CI: 0.23–0.74) (García-Pérez et al., 2026).

7.3 Academic, Social and Cultural Stressors Specific to Female Students

Stressors affecting female students fall into three categories. Academic and professional transition pressures, including anxiety about maintaining high performance, uncertainty about the future and dense schedules, create a continuous pressure field affecting both the sleep cycle and activity regularity (Oftedal et al., 2023; Mahmoud et al., 2026). Biological and menstrual stress includes hormonal fluctuation and dysmenorrhea, generating physical discomfort, mood change, and sleep disruption (Baker & Driver, 2007; Rizvi et al., 2026). The third category consists of cultural and traditional role expectations, which place an additional burden of domestic responsibility and family propriety on female students in conservative environments; in a study of Jordanian female students, exercise in public spaces was perceived as inconsistent with religious-cultural norms (Kanaan et al., 2023). In the Indian rural and semi-urban context this restriction often operates not as formal prohibition but as informal social surveillance, whose effect is equally constraining.

7.4 Commonly Used Measurement Instruments

Measurement instruments in this field are divided into two categories. For measuring negative symptoms, the major tools include the PHQ-9 and its eight-item version PHQ-8 (Kroenke et al., 2001; Whitehead & Horton, 2025), CES-D (Radloff, 1977; Falsafi, 2016), GAD-7 (Spitzer et al., 2006; Sun et al., 2021), STAI (Spielberger et al., 1983), BAI (Paolucci et al., 2018), PSS (Cohen et al., 1983), and SCL-90 (Yu et al., 2019). For measuring positive resources, the Flourishing Scale (Diener et al., 2010), the short form of the Mental Health Continuum (Keyes, 2002), and the Rosenberg Self-Esteem Scale (Rosenberg, 1965; Bermejo-Cantarero et al., 2025) are used. From a methodological perspective, two cautions are important here. First, all these instruments are self-reported, and therefore their scores may be affected by social-desirability bias, especially in cultural contexts where admitting psychological distress is considered stigmatizing. Second, their use is valid for symptom screening rather than clinical diagnosis. An integrated description of the instruments is presented in Table 4.

Table 4. Commonly used instruments for assessing psychological well-being and distress

Category	Instrument	Measured Dimensions	Source Reference
Depression	PHQ-9 / PHQ-8	Severity of depression; classification according to clinical criteria	Kroenke et al. (2001)

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

Depression	CES-D	Community-level prevalence of depressive symptoms	Radloff (1977)
Anxiety	GAD-7	Symptoms and severity of generalized anxiety	Spitzer et al. (2006)
Anxiety	STAI (Form Y)	Separate measurement of state anxiety and trait anxiety	Spielberger et al. (1983)
Stress	PSS-10 / PSS-14	Perceived stress appraisal in response to daily events	Cohen et al. (1983)
Overall distress	SCL-90	Multidimensional psychological distress profile	Yu et al. (2019)
Positive well-being	Flourishing Scale	Positive relationships, life purpose, optimism, and social competence	Diener et al. (2010)
Positive well-being	MHC-SF	Emotional, psychological, and social well-being under the dual-continuum model	Keyes (2002)
Self-esteem	RSES	Global self-esteem and self-evaluation	Rosenberg (1965)

8. Interrelationships among the Four Constructs: Synthesis of Evidence

8.1 Physical Activity and Psychological Well-being

8.1.1 Cross-Sectional and Longitudinal Evidence

Cross-sectional evidence shows a consistent protective relationship between physical activity and mental-health indicators among female students (Bermejo-Cantarero et al., 2025; Gao et al., 2025), while qualitative evidence adds a more concerning dimension: university entry is itself a health-eroding transition in which activity, diet, sleep and mental well-being decline together (Oftedal et al., 2023). Female students who maintain MVPA through this transition show better mental health despite academic pressure, suggesting that activity functions as a buffer. These cross-sectional associations should not, however, be treated as causal: it is equally possible that female students with better mental health are more active.

8.1.2 Experimental and Intervention Evidence

A systematic review and meta-analysis of randomized controlled trials among university students, including 80 studies from 34 articles and 8,020 participants, confirmed strong effects of exercise interventions on mental health (Liu et al., 2025). A large positive effect was recorded for overall mental health (SMD = 0.91), with improvements in positive well-being (SMD = 0.41) and reductions in anxiety (SMD = −0.62), depression (SMD = −0.67) and perceived stress (SMD = −0.46). These effect sizes fall within the moderate-to-large range for behavioural interventions and establish exercise not merely as an adjunct to pharmacological treatment but as an independent, evidence-based non-pharmacological intervention. Subgroup analyses indicated that three or fewer sessions per week over 10 to 48 weeks were most effective, and that resistance training and high-intensity interval training were strongest for anxiety, depression and stress, whereas aerobic exercise and mind-body practices were more effective for sleep quality and emotional regulation (Liu et al., 2025).

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

8.2 Physical Activity and Sleep Quality

The strongest available evidence on the relationship between exercise and sleep comes from a network meta-analysis that included 7,276 participants from 86 randomized controlled trials (Wang et al., 2025). All exercise modalities showed significant improvements in sleep quality compared with control conditions, but their relative effectiveness differed. Pilates produced the largest effect (SMD = −1.65; 95% CI: −2.42 to −0.88), followed by aerobic exercise (SMD = −1.21; 95% CI: −1.50 to −0.91), resistance training (SMD = −1.12; 95% CI: −1.80 to −0.44), combined aerobic and resistance exercise (SMD = −1.11; 95% CI: −1.56 to −0.66), traditional Chinese exercise (SMD = −0.94; 95% CI: −1.28 to −0.60), and yoga (SMD = −0.82; 95% CI: −1.22 to −0.42).

In the SUCRA ranking, Pilates ranked first (91.7%) and aerobic exercise ranked second (69.7%). The most practical finding concerns dosage: the optimal overall dose was approximately 920 MET-minutes per week, and the dose–response relationship was nonlinear and U-shaped, meaning that both too little and too much exercise reduced the benefit (Wang et al., 2025). This relationship is not purely biological. In a study of 1,308 Chinese college students, the pathway from physical activity to happiness was found to operate through the chained mediation of exercise attitude and sleep quality (Li et al., 2025), meaning that sleep is not merely an outcome of exercise but an essential link in the pathway from exercise to well-being.

8.3 Sedentary Behaviour, Sleep and Mental Health

Sedentary behaviour affects both sleep and mental health, but not uniformly: for depression risk there is a clear distinction between mentally passive and mentally active sedentary behaviour (Huang et al., 2020). In the sleep pathway the effect operates through screen exposure. The association between smartphone addiction and sedentary behaviour (Nambirajan et al., 2025), together with device-based evidence that inactive students had about 15% more daily screen time than active students (Shi et al., 2025), indicates a self-reinforcing cycle: more screen time, lower activity and delayed bedtime, poorer sleep, greater next-day fatigue, and still more sedentary screen use.

8.4 Sleep Quality and Psychological Well-being

The relationship between sleep and psychological well-being is the strongest and most bidirectional of the four paired relationships reviewed here, and a systematic review and meta-analysis of poor sleep, insomnia symptoms and stress in undergraduates confirmed its consistency (Gardani et al., 2022). The co-occurrence of poor sleep with anxiety and depression was so widespread in the UK study that only 18.1% of female students fell into the "good sleep + low distress" category (Whitehead & Horton, 2025), whereas in the Chinese sample the adjusted association was significant among male students but not among female students, even though overall symptom prevalence was higher among women (Yang et al., 2023). This contradiction may indicate that determinants of psychological distress among female students include social, academic, and biological pathways beyond sleep that carry greater weight.

8.5 Integrated Evidence: Compositional and Isotemporal Substitution Analyses

For sleep outcomes, the multicentre study of 8,059 undergraduate students from eight Brazilian universities is instructive. The substitution analysis showed a clear dose–response trend: replacing 30 minutes of sedentary time with moderate activity reduced the likelihood of poor sleep to OR = 0.86, replacing it with vigorous activity reduced it to OR = 0.88, and a 120-minute substitution reduced it to OR = 0.60 (95% CI: 0.50–0.70) (Menezes-Júnior et al., 2024). In an extended analysis of the same group focusing on mental-health outcomes, 55.09% of participants reported more than nine hours of sedentary time per day and 48.28% reported physical inactivity. Non-adherence to movement guidelines was associated with anxiety (OR = 1.89; 95% CI: 1.67–2.14) and depression (OR = 2.49; 95% CI: 2.19–2.82), and across all substitution models from 5 to 60 minutes,

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

replacing sedentary time with activity reduced the likelihood of both outcomes (Barbosa et al., 2025). Among compositional studies, compositional data analysis in Chinese college students confirmed the association between the 24-hour movement-behaviour composition and depression (Huang et al., 2025), while a sex- and depression-stratified analysis of 1,399 Chinese university students highlighted the association between guideline adherence and academic anxiety (Luo et al., 2026). The integrated summary of key studies is given in Table 5.

Table 5. Summary of key studies on the interrelationships among the four constructs

Study	Country and Sample	Design	Key Findings
Liu et al. (2025)	Multicountry; 80 studies, N = 8,020	Meta-analysis of RCTs	Exercise interventions: mental health SMD = 0.91; well-being 0.41; anxiety −0.62; depression −0.67; stress −0.46
Wang et al. (2025)	Multicountry; 86 RCTs, N = 7,276	Network meta-analysis	Most effective for sleep quality: Pilates (−1.65), aerobic exercise (−1.21); optimal dose ≈ 920 MET-min/week (U-shaped)
Menezes-Júnior et al. (2024)	Brazil; N = 8,059	Multicentre cross-sectional; isotemporal substitution	Sedentary time → activity substitution reduced likelihood of poor sleep: 30 min OR = 0.86; 120 min OR = 0.60
Barbosa et al. (2025)	Brazil; N = 8,059	Cross-sectional; isotemporal substitution	Guideline non-adherence: anxiety OR = 1.89; depression OR = 2.49; substitution produced dose–response reductions in both
García-Pérez et al. (2026)	Spain; N = 1,469	Cross-sectional	24-HMG adherence: low self-esteem AOR = 0.40; low resilience AOR = 0.41
Gao et al. (2025)	China (Yunnan); N = 455	Mediation analysis	Mediating role of physical activity: 23.66% among female students and 11.93% among male students
Li et al. (2025)	China; N = 1,308	Chain mediation	Physical activity → exercise attitude → sleep quality → happiness
Castro et al. (2020)	Multicountry; 125 studies	Systematic review and meta-analysis	Sedentary time: self-reported 7.29 h/day vs device-based 9.82 h/day; increasing trend over a decade

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

Whitehead & Horton (2025)	United Kingdom; N = 486	Multiyear cross-sectional	Female students: 59% at PSQI ≥6; 68% at GAD-7 ≥5; 73% at PHQ-8 ≥5; only 18.1% good sleep + low distress
Mahmoud et al. (2026)	Saudi Arabia; N = 248	Cross-sectional	70.6% had poor sleep (PSQI >5); flourishing correlated negatively with daytime dysfunction (r = −0.409) and PSQI (r = −0.327)

8.6 Mediating and Moderating Pathways Specific to Female Students

Four pathway structures specific to female students emerge from this evidence. The first concerns sleep as a mediator, since the route from physical activity to happiness passes through sleep quality (Li et al., 2025); an exercise programme that fails to improve sleep, for example because it relies on late-night sessions, will yield a lower psychological return than expected. In the second, sex functions as a moderator: the mediating role of activity between physical self-efficacy and well-being was almost twice as strong among female as among male students (Gao et al., 2025), suggesting that the group with the lowest participation rate may have the greatest potential benefit. The third concerns screen time and menstrual symptoms, which among female students were mutually associated with sleep quality, with emotional well-being as the central axis; this pathway is absent among male students and is therefore overlooked by gender-neutral models (Rizvi et al., 2026). The fourth concerns combined adherence, in which joint adherence to all three movement behaviours is linked far more strongly with positive psychological resources than adherence to any single behaviour (García-Pérez et al., 2026; Luo et al., 2026).

9. Discussion

9.1 Principal Findings

Five major findings emerge from this synthesis. First, the simultaneous presence of risk across all four behavioural domains among female college students is the rule rather than the exception; the "healthy female student" is in the minority, and intervention policy should begin from this reality. Second, the gender gap is not as simple as is often assumed: in physical activity it is consistent and strong at the population level (Guthold et al., 2018), but in sleep it was not significant at the level of overall prevalence in meta-analytic evidence (Li et al., 2020; Zhang et al., 2026), although component-level scores and psychological symptom prevalence were higher among female students (Becker et al., 2018; Yang et al., 2023). Third, intervention evidence is unambiguously positive: the problem is serious, but the remedy is available, low-cost, and effective. Fourth, the dose-response relationship is nonlinear, and the appropriate principle is "enough, regular, and sustainable." Fifth, the integrated approach is superior to the single-behaviour approach, since joint adherence to all three movement behaviours was much more strongly associated with positive psychological resources (García-Pérez et al., 2026), and substitution analyses showed that benefits depend on where time is taken from and where it is reallocated (Barbosa et al., 2025; Menezes-Júnior et al., 2024).

9.2 Methodological Tensions within the Evidence Base

Three methodological tensions exist within the evidence base, and ignoring them may lead to overinterpretation. The first concerns measurement: the systematic difference of about two and a half hours per day between self-reported and device-based estimates of sedentary time (Castro et al., 2020) makes a single pooled estimate across both study types of problematic, and much of the older literature further confuses "sedentary behaviour" with "physical inactivity," contrary to the consensus definition (Tremblay et al., 2017).

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

The second is cut-off dependence, since the choice between PSQI > 5 and PSQI > 7 shifts prevalence estimates from 26% to 63%, invalidating direct comparison across cut-offs. The third concerns design, because most of the evidence base is cross-sectional and cannot determine the direction of bidirectional relationships; experimental meta-analyses fill this gap only partly, and female-specific subgroup analyses are often unavailable.

9.3 Gaps in the Literature, with Particular Reference to the South Asian Context

During the review process, five clear research gaps were identified. (a) Geographical imbalance. Device-based studies focused on South Asian, particularly Indian, female college students are extremely rare. This gap is not merely quantitative but conceptual, because the daily time budget of Indian female students, including the proportion of domestic work, commuting distance, safety restrictions, and the availability of privacy, differs from that of Western or East Asian samples.

(b) Methodological inclusion of the menstrual cycle. The literature on the effect of exercise on dysmenorrhea is well developed (Armour et al., 2019; Zhao et al., 2024), but the inclusion of cycle phase as a variable in general epidemiological studies of activity and sleep is extremely uncommon. As a result, a systematic and predictable source of variability in female students' activity remains outside measurement. (c) Lack of long-term longitudinal studies. Multi-wave longitudinal studies covering the entire period from university entry to graduation, especially those focused on female students, are extremely limited. (d) Sex-stratified analysis in intervention studies. Most exercise-intervention trials are based on mixed-sex samples and do not report sex-stratified effect sizes, although mediation analyses indicate that the effect structure is sex-differentiated (Gao et al., 2025). (e) Culturally adapted measurement instruments. The systematic use of validated Hindi and other Indian-language versions of instruments such as the PSQI, GAD-7, and PHQ-9 remains limited in college samples, making language barriers a potential source of measurement error.

10. Implications for Practice, Policy, and Institutions

10.1 Implications for Physical Education Practice and Curriculum

Four concrete directions emerge for the practical field of physical education. The first is a realistic frequency: the evidence supports three sessions per week over 10 to 48 weeks (Liu et al., 2025), so colleges should plan semester-long, thrice-weekly programmes rather than ambitious daily schedules. The second is a mixed programme type, since resistance training was most effective for anxiety and self-esteem while mind-body and aerobic methods were most effective for sleep quality and emotional regulation (Liu et al., 2025; Wang et al., 2025), and no single-type curriculum achieves both. The third is to include the menstrual cycle in the curriculum, since teaching female students that controlled light-to-moderate activity reduces dysmenorrhea (Armour et al., 2019) is a low-cost, high-impact way to shorten the recurring monthly activity break. The fourth is to make self-efficacy an explicit goal: because its effect on well-being is stronger among female students (Gao et al., 2025), gradual attainable goal setting and skill-building should outweigh evaluation-based performance (Ryan & Deci, 2000).

10.2 Implications for Institutional Policy and Campus Infrastructure

At the institutional level the evidence supports reserved gymnasium hours and visual privacy for female students, adequate and clean changing rooms, evening lighting and safety patrols, permission for flexible and modesty-compatible sports clothing, and active communication of facility schedules (Kanaan et al., 2023; Manalad et al., 2026; Wilson et al., 2022). An equally important but often overlooked academic-administrative intervention is circadian reconsideration of class timetables, since exceedingly early morning classes institutionally produce social jetlag in populations dominated by evening chronotypes (Baron & Reid, 2014). Brief movement breaks every 50 to 60 minutes can change the accumulation pattern of sedentary time at no

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

financial cost, and sleep-hygiene counselling should be a regular part of college counselling services, because sleep is one of the few intervention points that influences academic performance and mental health simultaneously.

10.3 Implications for Public Health and Research Policy

The college campus is a unique public-health intervention site: the target population is available for several years within a defined geographical location and institutional structure. To make appropriate use of this opportunity, national-level 24-hour movement guidelines (Ross et al., 2020; World Health Organization, 2020) must be adapted to the college context, and adherence should be monitored regularly. From the perspective of research policy, three priorities can be identified: (i) device-based, multicentre baseline studies on Indian female college students; (ii) protocols that regularly include menstrual-cycle phase as a covariate; and (iii) mandatory reporting of sex-stratified effect sizes in intervention trials.

11. Limitations and Directions for Future Research

A clear statement of four limitations of the present review is necessary: (i) it is a narrative review; therefore, it does not include formal risk-of-bias assessment or calculation of pooled effect sizes; (ii) inclusion was limited to publications in English and Hindi, which may have excluded many relevant studies published in Chinese, Arabic, or Portuguese, and this limitation is particularly important because a large part of the evidence base in this field comes from East Asia; (iii) the inclusion of only published studies leaves open the possibility of publication bias; and (iv) because of the high heterogeneity of sample structure, cut-offs, and measurement systems, only qualitative indications rather than quantitative comparisons could be presented in many places. Five recommendations are proposed for future research: (i) multicentre studies based on actigraphy and accelerometry among Indian and South Asian female college students; (ii) multi-wave longitudinal designs covering the entire period from university entry to graduation; (iii) micro-longitudinal protocols that control for menstrual-cycle phase; (iv) cluster-randomized trials examining the impact of gender-responsive infrastructural interventions; and (v) systematic use and psychometric testing of validated versions of major measurement instruments in Indian languages, including Hindi.

12. Conclusion

The central conclusion of this narrative review is that physical activity, sedentary behaviour, sleep quality, and psychological well-being among female college students are not four separate problems but four interdependent dimensions of the same 24-hour system. Inadequate activity, excessive sedentary behaviour, fragmented sleep, and psychological distress are often present together in this population, and their combined burden is greater among female than male students, though it is not distributed equally across all indicators. The encouraging aspect is that intervention evidence is strong and practical: a planned mixed-exercise programme at a realistic frequency improves both mental health and sleep quality, and replacing even small segments of sedentary time with activity generates measurable benefit. The necessary condition is that interventions acknowledge the real biological, psychological and sociocultural context of female students: the cyclicity of the menstrual cycle, body-image hesitation, the need for safety and privacy, and the burden of family and social expectations.

The most immediate need in this field is for high-quality, device-based, and gender-sensitive baseline data in the Indian context. Until this evidence base is developed, policymaking in Indian colleges will continue to depend on evidence imported from other cultural contexts. Although useful in practical terms, this dependence is scientifically insufficient.

eISSN 2581-8996
ONLINE
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN MULTIDISCIPLINARY SCIENCES (IJARMS)
A BI-ANNUAL, OPEN ACCESS, PEER REVIEWED JOURNAL
Volume 09, Issue 01, January 2026

References

Abdulghani, H. M., AlKanhal, A. A., Mahmoud, E. S., Ponnamperuma, G. G., & Alfaris, E. A. (2011). Stress and its effects on medical students: A cross-sectional study at a college of medicine in Saudi Arabia. *Journal of Health, Population and Nutrition, 29*(5), 516-522. https://doi.org/10.3329/jhpn.v29i5.8906

Alzamil, H. A., Alhakbany, M. A., Alfadda, N. A., Almusallam, S. M., & Al-Hazzaa, H. M. (2019). A profile of physical activity, sedentary behaviors, sleep, and dietary habits of Saudi college female students. *Journal of Family & Community Medicine, 26*(1), 1-8. https://doi.org/10.4103/jfcm.JFCM_58_18

Armour, M., Ee, C. C., Naidoo, D., Ayati, Z., Chalmers, K. J., Steel, K. A., de Manincor, M. J., & Delshad, E. (2019). Exercise for dysmenorrhoea. *Cochrane Database of Systematic Reviews, 2019*(9), Article CD004142. https://doi.org/10.1002/14651858.CD004142.pub4

Baker, F. C., & Driver, H. S. (2007). Circadian rhythms, sleep, and the menstrual cycle. *Sleep Medicine, 8*(6), 613-622. https://doi.org/10.1016/j.sleep.2006.09.011

Barbosa, B. C. R., Menezes-Júnior, L. A. A., Fróis, L. F., Vidigal, M. C. A., de Paula, W., Chagas, C. M. S., Machado, E. L., Nobre, L. N., de Freitas, E. D., Vidigal, F. C., Cardoso, C. S., Silva, L. S., & Meireles, A. L. (2025). Replacing sedentary behavior with physical activity reduces symptoms of anxiety and depression: A study with young adults. *BMC Public Health, 25*, Article 2971. https://doi.org/10.1186/s12889-025-23523-4

Baron, K. G., & Reid, K. J. (2014). Circadian misalignment and health. *International Review of Psychiatry, 26*(2), 139-154. https://doi.org/10.3109/09540261.2014.911149

Becker, S. P., Jarrett, M. A., Luebbe, A. M., Garner, A. A., Burns, G. L., & Kofler, M. J. (2018). Sleep in a large, multi-university sample of college students: Sleep problem prevalence, sex differences, and mental health correlates. *Sleep Health, 4*(2), 174-181. https://doi.org/10.1016/j.sleh.2018.01.001

Bermejo-Cantarero, A., Velázquez-Ruiz, L., Romero-Blanco, C., Expósito-González, R., Onieva-Zafra, M. D., Rodríguez-Almagro, J., & Sánchez-López, M. (2025). Relationship between self-esteem and physical activity in university students. Gender differences: Cross-sectional study. *Nursing Open, 12*(4), Article e70205. https://doi.org/10.1002/nop2.70205

Biswas, A., Oh, P. I., Faulkner, G. E., Bajaj, R. R., Silver, M. A., Mitchell, M. S., & Alter, D. A. (2015). Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: A systematic review and meta-analysis. *Annals of Internal Medicine, 162*(2), 123-132. https://doi.org/10.7326/M14-1651

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J.-P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., … Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine, 54*(24), 1451-1462. https://doi.org/10.1136/bjsports-2020-102955

Buysse, D. J. (2014). Sleep health: Can we define it? Does it matter? *Sleep, 37*(1), 9-17. https://doi.org/10.5665/sleep.3298

Buysse, D. J., Reynolds, C. F., III, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4

Castro, O., Bennie, J., Vergeer, I., Bosselut, G., & Biddle, S. J. H. (2020). How sedentary are university students? A systematic review and meta-analysis. *Prevention Science, 21*(3), 332-343. https://doi.org/10.1007/s11121-020-01093-8

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396. https://doi.org/10.2307/2136404

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*(8), 1381-1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research, 97*(2), 143-156. https://doi.org/10.1007/s11205-009-9493-y

Eisenberg, D., Hunt, J., & Speer, N. (2013). Mental health in American colleges and universities: Variation across student subgroups and across campuses. *The Journal of Nervous and Mental Disease, 201*(1), 60-67. https://doi.org/10.1097/NMD.0b013e31827ab077

Ekelund, U., Steene-Johannessen, J., Brown, W. J., Fagerland, M. W., Owen, N., Powell, K. E., Bauman, A., & Lee, I.-M. (2016). Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet, 388*(10051), 1302-1310. https://doi.org/10.1016/S0140-6736(16)30370-1

Falsafi, N. (2016). A randomized controlled trial of mindfulness versus yoga: Effects on depression and/or anxiety in college students. *Journal of the American Psychiatric Nurses Association, 22*(6), 483-497. https://doi.org/10.1177/1078390316663307

Gao, Z., Li, X., & Liu, J. (2025). Physical fitness self-efficacy influences college students' subjective well-being through the mediating role of physical activity and the moderating effect of gender. *International Journal of Sports Science and Physical Education, 10*(1), 27-37. https://doi.org/10.11648/j.ijsspe.20251001.14

García-Pérez, L., Torres-Luque, G., Lucena Martins, C. M., & Padial-Ruz, R. (2026). 24-h movement guideline adherence and mental health in university students: Patterns across adherence levels and academic fields. *Behavioral Sciences, 16*(5), Article 766. https://doi.org/10.3390/bs16050766

Gardani, M., Bradford, D. R. R., Russell, K., Allan, S., Beattie, L., Ellis, J. G., & Akram, U. (2022). A systematic review and meta-analysis of poor sleep, insomnia symptoms, and stress in undergraduate students. *Sleep Medicine Reviews, 61*, Article 101565. https://doi.org/10.1016/j.smrv.2021.101565

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1·9 million participants. *The Lancet Global Health, 6*(10), e1077-e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Heller, S., Kalo, K., Werner, A. M., Eisenbarth, L., Reichel, J. L., Mülder, L. M., Schäfer, M., Letzel, S., Simon, P., Rigotti, T., & Dietz, P. (2023). Sedentary time of university students before and during the COVID-19 pandemic: Risk groups and pre-pandemic predictors using cross-sectional and longitudinal data. *Frontiers in Public Health, 11*, Article 1138442. https://doi.org/10.3389/fpubh.2023.1138442

Huang, Y., Li, L., Gan, Y., Wang, C., Jiang, H., Cao, S., & Lu, Z. (2020). Sedentary behaviors and risk of depression: A meta-analysis of prospective studies. *Translational Psychiatry, 10*(1), Article 26. https://doi.org/10.1038/s41398-020-0715-z

Huang, Z., Chen, B., Dong, X., He, J., Liu, Y., Li, J., & Zhou, Y. (2025). Association between 24-hour movement behavior and depression in college students: A compositional data analysis. *Journal of Affective Disorders, 369*, 531-537. https://doi.org/10.1016/j.jad.2024.10.039

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep, 14*(6), 540-545. https://doi.org/10.1093/sleep/14.6.540

Kanaan, E. M., Ahmed, M. D., & López Sánchez, G. F. (2023). Sport participation, lifestyle habits, and determinants of female students from Jordan: A qualitative analysis. *Journal of Sport and Health Research, 15*(2). https://doi.org/10.58727/jshr.91551 [CHECK]

Keyes, C. L. M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior, 43*(2), 207-222. https://doi.org/10.2307/3090197

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606-613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Li, K., Omar Dev, R. D., & Li, W. (2025). Physical activity and happiness of college students: Chain mediating role of exercise attitude and sleep quality. *Frontiers in Public Health, 13*, Article 1544194. https://doi.org/10.3389/fpubh.2025.1544194

Li, Y., Bai, W., Zhu, B., Duan, R., Yu, X., Xu, W., Wang, M., Hua, W., Yu, W., Li, W., & Kou, C. (2020). Prevalence and correlates of poor sleep quality among college students: A cross-sectional survey. *Health and Quality of Life Outcomes, 18*(1), Article 210. https://doi.org/10.1186/s12955-020-01465-2

Liu, L., Xin, X., Wang, H., & Zhang, Y. (2025). Effectiveness of physical exercise on mental health among university students: A systematic review and meta-analysis. *Frontiers in Psychology, 16*, Article 1612408. https://doi.org/10.3389/fpsyg.2025.1612408

Luo, L., Zhang, L., Wang, Y., Bi, S., Zhu, R., Cao, Y., & Hu, Y. (2026). Associations between adherence to 24-hour movement behavior guidelines and academic anxiety in Chinese university students: Stratified analyses by sex and depressive symptoms. *BMC Psychology, 14*, Article 799. https://doi.org/10.1186/s40359-026-04535-0

Ma, J., Guo, Y., Zhu, C., Wen, C., Deng, Q., & Ma, X. (2025). Teaching strategies for promoting female college students' physical activity. *Frontiers in Psychology, 16*, Article 1569578. https://doi.org/10.3389/fpsyg.2025.1569578

Mahmoud, N. F., Alghamdi, L., Almuaither, T., Alqabani, R., Alabdulathim, D., Alotaibi, M., Almuwais, A., & Atya, A. M. (2026). Association between psychological well-being, sleep quality, and academic performance among physical therapy students. *Frontiers in Medicine, 13*, Article 1704952. https://doi.org/10.3389/fmed.2026.1704952

Manalad, E., Villanueva, A. V., & Salazar, N. (2026). "It felt like something to endure": A feminist phenomenological inquiry into low PE motivation among Filipino female college students. *International Sports Studies, 48*(SI), 24-36. https://doi.org/10.69665/iss.v48i1S.135

Menezes-Júnior, L. A. A., Barbosa, B. C. R., de Paula, W., Ferreira, A. D., Cardoso, C. S., de Freitas, E. D., Vidigal, F. C., Ferreira, L. G., Nobre, L. N., Silva, L. S., & Meireles, A. L. (2024). Isotemporal substitution analysis of time between sedentary behavior, and physical activity on sleep quality in younger adults: A multicenter study. *BMC Public Health, 24*, Article 2460. https://doi.org/10.1186/s12889-024-19995-5

Nakie, G., Takelle, G. M., Rtbey, G., Andualem, F., Tinsae, T., Kassa, M. A., Tadesse, G., Fentahun, S., Wassie, Y. A., Segon, T., Kibralew, G., & Melkam, M. (2024). Sleep quality and associated factors among university students in Africa: A systematic review and meta-analysis study. *Frontiers in Psychiatry, 15*, Article 1370757. https://doi.org/10.3389/fpsyt.2024.1370757

Nambirajan, M. K., Vidusha, K., Kailasam, J. G., Kannan, S., Govindan, D., Ganesh, K., Sethumadhavan, U., Priyan, S., & Krishnamoorthy, Y. (2025). Association between smartphone addiction and sedentary behaviour amongst children, adolescents, and young adults: A systematic review and meta-analysis. *Journal of Psychiatric Research, 184*, 128-139. https://doi.org/10.1016/j.jpsychires.2025.02.049

Oftedal, S., Fenton, S., Hansen, V., Whatnall, M. C., Ashton, L. M., Haslam, R. L., Hutchesson, M. J., & Duncan, M. J. (2023). Changes in physical activity, diet, sleep, and mental well-being when starting university: A qualitative exploration of Australian student experiences. *Journal of American College Health, 72*(9), 3715-3724. https://doi.org/10.1080/07448481.2023.2194426

Paolucci, E. M., Loukov, D., Bowdish, D. M. E., & Heisz, J. J. (2018). Exercise reduces depression and inflammation but intensity matters. *Biological Psychology, 133*, 79-84. https://doi.org/10.1016/j.biopsycho.2018.01.015

Pengpid, S., Peltzer, K., Kassean, H. K., Tsala Tsala, J. P., Sychareun, V., & Müller-Riemenschneider, F. (2015). Physical inactivity and associated factors among university students in 23 low-, middle- and high-income countries. *International Journal of Public Health, 60*(5), 539-549. https://doi.org/10.1007/s00038-015-0680-0

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385-401. https://doi.org/10.1177/014662167700100306

Rizvi, S. H. Z., Kamran, S., Ilyas, S., Massod, F., Ali, S., Maryam, A., & Razzaq, F. (2026). Exploring the link of screen time with emotional well-being, quality of sleep and menstrual symptoms among undergraduate university students. *Journal of Health, Wellness and Community Research, 4*(10), 1-9. https://doi.org/10.61919/f6454n09

Roque, A. R., Martin, J., Baltazar, J., & Baltazar, S. (2026). Hiya and the gymnasium: Body image, shame, and self-perception among Filipino female college students in physical education. *International Sports Studies, 48*(SI), 37-50. https://doi.org/10.69665/iss.v48i1S.144

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton University Press. https://doi.org/10.1515/9781400876136

Ross, R., Chaput, J.-P., Giangregorio, L. M., Janssen, I., Saunders, T. J., Kho, M. E., Poitras, V. J., Tomasone, J. R., El-Kotob, R., McLaughlin, E. C., Duggan, M., Carrier, J., Carson, V., Chastin, S. F., Latimer-Cheung, A. E., Chulak-Bozzer, T., Faulkner, G., Flood, S. M., Gazendam, M. K., … Tremblay, M. S. (2020). Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years and Adults aged 65 years or older: An integration of physical activity, sedentary behaviour, and sleep. *Applied Physiology, Nutrition, and Metabolism, 45*(10, Suppl. 2), S57-S102. https://doi.org/10.1139/apnm-2020-0467

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. https://doi.org/10.1037/0003-066X.55.1.68

Shi, M., Zhao, Z., & Fan, X. (2025). Associations of accelerometer-measured physical activity, sedentary behaviour, and diverse types of smartphone apps usage among university students: A 7-day tracking study. *BMC Public Health, 25*, Article 4336. https://doi.org/10.1186/s12889-025-25588-7

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory (Form Y)*. Consulting Psychologists Press.

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*(10), 1092-1097. https://doi.org/10.1001/archinte.166.10.1092

Sun, J., Liang, K., Chi, X., & Chen, S. (2021). Psychometric properties of the Generalized Anxiety Disorder Scale-7 Item (GAD-7) in a large sample of Chinese adolescents. *Healthcare, 9*(12), Article 1709. https://doi.org/10.3390/healthcare9121709

Tao, X., Wu, X., Zhuo, S., Fu, J., Xiao, Y., Zhao, Y., Liao, J., & Zhong, T. (2025). Unveiling the sedentary epidemic through insights from college students in Guangdong. *Scientific Reports, 15*, Article 35197. https://doi.org/10.1038/s41598-025-19018-2

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S. F. M., Altenburg, T. M., & Chinapaw, M. J. M. (2017). Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity, 14*, Article 75. https://doi.org/10.1186/s12966-017-0525-8

Wang, H., Xin, X., & Pan, Y. (2025). The best approaches and doses of exercise for improving sleep quality: A network meta-analysis and dose-response relationship study. *BMC Public Health, 25*, Article 1371. https://doi.org/10.1186/s12889-025-22570-1

Whitehead, J. P., & Horton, C. L. (2025). Relationships between sleep quality, anxiety, and depression in university students: Stable trends over time and a pronounced concern for sleep initiation. *Brain Sciences, 15*(11), Article 1142. https://doi.org/10.3390/brainsci15111142

Wilke, J., Rahlf, A. L., Füzéki, E., Groneberg, D. A., Hespanhol, L., Mai, P., de Oliveira, G. M., Robbin, J., Tan, B., Willwacher, S., Hollander, K., & Pillay, J. D. (2022). Physical activity during lockdowns associated with the COVID-19 pandemic: A systematic review and multilevel meta-analysis of 173 studies with 320,636 participants. *Sports Medicine – Open, 8*(1), Article 125. https://doi.org/10.1186/s40798-022-00515-x

Wilson, O. W. A., Colinear, C., Guthrie, D., & Bopp, M. (2022). Gender differences in college student physical activity, and campus recreational facility use, and comfort. *Journal of American College Health, 70*(5), 1315-1320. https://doi.org/10.1080/07448481.2020.1804388

World Health Organization. (2020). *WHO guidelines on physical activity and sedentary behaviour*. https://www.who.int/publications/i/item/9789240015128

Yang, G., Hu, Y., Liu, J., Zhao, Z., Bi, C., Cao, H., & Liu, H. (2023). Association between sleep quality and psychological symptoms: A cross-sectional survey of Chinese university students performed during the COVID-19 pandemic. *Frontiers in Psychology, 14*, Article 1131176. https://doi.org/10.3389/fpsyg.2023.1131176

Youngstedt, S. D., Elliott, J. A., & Kripke, D. F. (2019). Human circadian phase–response curves for exercise. *The Journal of Physiology, 597*(8), 2253-2268. https://doi.org/10.1113/JP276943

Yu, Y., Wan, C., Huebner, E. S., Zhao, X., Zeng, W., & Shang, L. (2019). Psychometric properties of the Symptom Check List 90 (SCL-90) for Chinese undergraduate students. *Journal of Mental Health, 28*(2), 213-219. https://doi.org/10.1080/09638237.2018.1521939

Zhang, H., Guo, Z., & Peng, Q. (2026). Prevalence of sleep disturbance among Chinese college students: An updated meta-analysis. *BMC Psychiatry, 26*(1), Article 347. https://doi.org/10.1186/s12888-026-07997-z

Zhao, Y., Zheng, Q., Huang, G., & Cao, W. (2024). Comparative effectiveness of exercise interventions for primary dysmenorrhea: A systematic review and network meta-analysis. *BMC Women's Health, 24*(1), Article 610. https://doi.org/10.1186/s12905-024-03453-w