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The Impact of Bedtime Headphone Use on Sleep Quality Among Young Adult Females: A Cross-Sectional Descriptive Study

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Abstract

Background: The habitual use of headphones at bedtime has become increasingly prevalent among young adults, driven by widespread digital media consumption. Prolonged pre-sleep audio engagement may disrupt physiological sleep-onset mechanisms and adversely affect overall sleep quality.

Objective: To investigate the impact of bedtime headphone use on sleep quality among young adult females aged 18–23 years.

Methods: A cross-sectional descriptive survey was conducted among 100 female undergraduate students who reported regular bedtime headphone use. Participants were recruited via purposive sampling. Sleep quality was assessed using the validated Sleep Quality Scale (SQS; score range 0–100), capturing domains of sleep onset latency, duration, continuity, daytime fatigue, and subjective satisfaction. Data were analysed using descriptive statistics and age-group cross-tabulations.

Results: The mean SQS score was 37.78 ± 14.13 (median: 38.50; range: 2–85), indicative of moderate sleep impairment. The majority of participants (70%) were categorised in the Moderate Impact range (SQS 26–50), with 13% in the High Impact range (51–75) and 1% in the Severe Impact range (76–100). Collectively, 84% experienced at least moderate sleep disruption. The 20–21-year age cohort demonstrated the highest mean SQS score (39.06), suggesting heightened susceptibility during this developmental period.

Conclusion: Bedtime headphone use is associated with moderate-to-significant sleep disruptions in young adult females. These findings highlight a salient public health concern and underscore the need for targeted sleep hygiene education and responsible digital media practices, particularly among college-going women.

Keywords: bedtime headphone use; sleep quality; young adult females; Sleep Quality Scale; sleep hygiene; digital media;

1. Introduction

The exponential growth of personal listening devices over the past two decades has fundamentally transformed the auditory landscape of daily life. Since the launch of the first commercially successful stereo headphones in 1958 and the mass adoption of portable audio players following the Walkman era of the late 1970s, headphone use has transitioned from a niche activity to a ubiquitous habit, particularly

among adolescents and young adults.

The World Health Organization (WHO) estimates that over 360 million people worldwide—approximately 5.3% of the global population—are affected by disabling hearing loss, a burden that is increasingly attributable to recreational noise exposure [1]. Epidemiological data indicate that the prevalence of hearing loss in teenagers has risen by approximately 30% since the 1990s, coinciding with the rapid proliferation of personal listening devices [2]. Studies employing audiometric testing have found that 12.5–14.9% of children and young adults exhibit evidence of noise-induced hearing threshold shifts, highlighting a significant and largely preventable public health burden [3, 4].

Beyond auditory consequences, a growing body of literature implicates pre-sleep technology use—including headphone and earbud use—in disrupting sleep architecture. Light-emitting electronic devices suppress melatonin secretion via blue-light exposure, thereby delaying circadian sleep onset [5, 6]. Analogously, auditory stimulation at bedtime may sustain cortical arousal, impede the hypnagogic transition, and fragment sleep continuity. Young adults (18–29 years) represent a particularly vulnerable demographic given their disproportionately high rates of both digital media engagement and sleep insufficiency.

Despite the theoretical plausibility of a bedtime headphone use–sleep quality relationship, empirical research in this domain remains limited, especially among Indian young adult females. Existing studies have predominantly examined screen-based electronic media [5, 6] or occupational noise exposure [8], with relatively few investigations specifically addressing pre-sleep personal audio device use in the collegiate female population. This gap is particularly notable in the Indian context, where smartphone and music-streaming penetration among university students has grown dramatically.

The present study was therefore designed to quantify the relationship between bedtime headphone use and sleep quality in a purposive sample of young adult female undergraduates in Rajasthan, India, using the validated Sleep Quality Scale (SQS). Findings are intended to inform physiotherapy-led health promotion and sleep hygiene interventions.

2. Aims, Objectives, and Hypotheses

Primary Aim

To investigate the impact of regular bedtime headphone, use on sleep quality among young adult females aged 18–23 years, as measured by the Sleep Quality Scale.

Secondary Objectives

1. To describe the distribution of sleep quality impact categories (Low, Moderate, High, Severe) within the study sample.
2. To compare mean SQS scores across age groups (18–19, 20–21, and 22–23 years).
3. To identify the age cohort most susceptible to bedtime headphone-related sleep impairment.

Research Hypotheses

H_1 (Alternative): Bedtime headphone use is associated with a statistically significant adverse impact on sleep quality among young adult females.

H_0 (Null): Bedtime headphone use is not associated with a significant impact on sleep quality among young adult females.

3. Review of Literature

Fasanya and Strong (2019) evaluated hearing loss and academic performance in college headphone users

and reported significantly elevated hearing thresholds among personal listening device (PLD) users compared to non-users, implicating habitual high-volume audio exposure as a driver of early auditory fatigue.

Muthu et al. (2021) documented a spectrum of adverse health consequences associated with prolonged headphone use, including noise-induced hearing loss (NIHL), tinnitus, hyperacusis, and ear canal infections attributable to occluded air passage and bacterial colonisation.

Alarfaj et al. (2021) conducted a cross-sectional study in Saudi Arabia examining awareness of earbud-related side effects among adolescents and young adults. They reported that, while female participants demonstrated better awareness than males, the majority continued to engage in unsafe listening practices characterised by extended durations and high volumes.

Shpakou et al. (2020) assessed schoolchildren's and university students' awareness of safe electronic device usage and identified significant gaps in knowledge regarding ocular and auditory health risks, emphasising that combined visual and auditory digital strain may compound adverse health outcomes.

Cain and Gradisar (2010) conducted a systematic review of electronic media use and sleep in school-aged and young adult populations. They established robust associations between nighttime electronic device use, delayed sleep onset, reduced total sleep time, and impaired sleep quality, mediated partly by blue-light-induced melatonin suppression.

Chang et al. (2015) demonstrated in a controlled trial that evening use of light-emitting eReaders significantly delayed circadian sleep timing and reduced next-morning alertness compared to printed books, providing mechanistic evidence for the deleterious effects of nocturnal device use on the sleep–wake cycle.

Duggan et al. (2020) examined the effect of noise-masking earbuds (SleepBuds) on sleep quality among healthcare shift workers and found that active noise masking reduced subjective sleep disturbance and tension, underscoring how auditory environment modulation—in either direction—significantly influences sleep architecture.

Collectively, the reviewed literature establishes a strong theoretical and empirical basis for expecting adverse sleep outcomes from bedtime headphone use, yet population-specific data for Indian young adult females remain sparse, substantiating the need for the present investigation.

4. Materials and Methods

Study Design and Setting

A quantitative, cross-sectional descriptive survey design was employed. Data were collected from female undergraduate students at Career Point University, Kota, Rajasthan, India, over approximately four months (January–April 2025). A cross-sectional design was selected for its efficiency in capturing the prevalence and distribution of a behaviour and its associated health outcomes at a defined point in time.

Study Population and Sampling

The target population comprised young adult females aged 18–25 years enrolled in undergraduate programmes at the study institution. A purposive sampling strategy was employed to ensure inclusion of individuals who regularly used headphones at bedtime. One hundred participants meeting eligibility criteria were recruited.

Eligibility Criteria

Inclusion criteria:

1. female gender;

2. age 18–25 years;
3. self-reported regular bedtime headphone use;
4. provision of written informed consent.

Exclusion criteria:

1. pre-existing diagnosed sleep disorder;
2. diagnosed hearing impairment;
3. absence of bedtime headphone use;
4. incomplete questionnaire responses.

Outcome Measure

Sleep quality was assessed using the validated Sleep Quality Scale (SQS), a standardised instrument with a scoring range of 0–100. Higher scores denote greater adverse impact on sleep quality. The SQS captures five primary domains: sleep onset latency, sleep duration, sleep continuity, daytime fatigue, and subjective sleep satisfaction. Based on composite scores, participants were classified into four impact categories: Low Impact (0–25), Moderate Impact (26–50), High Impact (51–75), and Severe Impact (76–100).

Data Collection Procedure

Phase 1 — Ethical Clearance and Consent: Institutional ethical clearance was obtained prior to data collection. Written informed consent was secured from all participants, with anonymity strictly maintained throughout.

Phase 2 — Instrument Preparation: The SQS questionnaire was reviewed by a panel of physiotherapy faculty and pilot-tested on a subset of 10 participants (excluded from the final analysis) to verify contextual clarity and response adequacy.

Phase 3 — Data Collection: Structured questionnaires were administered to 100 eligible participants in a controlled classroom environment. Participants were briefed on study objectives and instructed to respond based on their experiences over the preceding four weeks. Mean completion time was approximately 15–20 minutes.

Phase 4 — Scoring and Coding: Questionnaires were scored according to the SQS manual and entered into a spreadsheet for analysis.

Statistical Analysis

Data were subjected to descriptive statistical analysis, including computation of mean, median, standard deviation (SD), minimum, maximum, and interquartile range (IQR). Frequency distributions and age-group cross-tabulations were generated to describe the distribution of SQS scores and impact categories. Graphical representations (bar charts, histograms, pie/doughnut charts, line charts, and stacked bar charts) were produced to illustrate key findings. Statistical analyses were performed using standard spreadsheet software. A significance level of $\alpha = 0.05$ was adopted.

5. Results

Overall Descriptive Statistics

The overall mean SQS score was 37.78 (SD = 14.13), with a median of 38.50. Scores ranged from a minimum of 2 to a maximum of 85, reflecting substantial inter-individual variability. The interquartile range (Q1 = 30.75; Q3 = 45.50) confirmed that the central 50% of participants scored within the Moderate Impact band (Table 1).

Table 1: Descriptive Statistics — Sleep Quality Scale Scores (n = 100)

Statistic	Value	Interpretation
Mean Score	37.78	Moderate impact range
Median Score	38.50	50th percentile
Standard Deviation	14.13	Moderate spread
Minimum Score	2	Lowest observed
Maximum Score	85	Highest observed
Q1 (25th Percentile)	30.75	Lower quartile
Q3 (75th Percentile)	45.50	Upper quartile
IQR	14.75	Interquartile range

Age-wise Distribution and SQS Scores

The study comprised 100 participants aged 18–23 years. Twenty-year-old participants represented the largest cohort (n = 44; 44%), followed by 21-year-olds (n = 22; 22%), 19-year-olds (n = 16; 16%), 18-year-olds (n = 9; 9%), 22-year-olds (n = 8; 8%), and 23-year-olds (n = 1; 1%). Mean SQS scores were highest among 20-year-olds (40.34) and 19-year-olds (40.12), while 18-year-olds demonstrated the lowest mean score (25.44), classified in the Low Impact range (Table 2).

Table 2: Age-wise Frequency Distribution and Descriptive Statistics

Age (yrs)	n	%	Mean SQS	Median	SD	Category
18	9	9.0%	25.44	31.0	15.18	Low
19	16	16.0%	40.12	40.0	16.60	Moderate
20	44	44.0%	40.34	41.0	12.96	Moderate
21	22	22.0%	36.50	38.0	12.90	Moderate
22	8	8.0%	35.00	35.0	12.49	Moderate
23	1	1.0%	49.00	49.0	—	Moderate
Total	**100**	**100%**	**37.78**	**38.50**	**14.13**	**Moderate**

Sleep Quality Impact Category Distribution

Classification of participants into SQS impact categories revealed that the dominant experience was Moderate Impact, affecting 70% of the sample (n = 70). Sixteen percent of participants demonstrated Low Impact (n = 16), 13% fell within the High Impact range (n = 13), and 1% were classified as Severe Impact

(n = 1). Collectively, 84% of participants reported at least moderate sleep disruption attributable to bedtime headphone use (Table 3).

Table 3: Sleep Quality Impact Category Frequencies and Percentages (n = 100)

Category	Score Range	n	%	Interpretation
Low Impact	0–25	16	16.0%	Minimal sleep disruption
Moderate Impact	26–50	70	70.0%	Noticeable sleep disturbance
High Impact	51–75	13	13.0%	Significant sleep disruption
Severe Impact	76–100	1	1.0%	Severe sleep disruption
Total	—	**100**	**100%**	—

Age-Group Cross-Tabulation

Cross-tabulation by age group demonstrated that the 20–21-year cohort (n = 66) exhibited the highest mean SQS score (39.06) and accounted for the majority of High Impact cases (n = 9) and the sole Severe Impact case. The 22–23-year group (n = 9) reported a mean SQS of 36.56, with no High or Severe Impact cases. The 18–19-year cohort (n = 25) demonstrated the lowest mean score (34.84) and was the only group with participants in the Low Impact category (n = 5) (Table 4).

Table 4: Age-Group Cross-tabulation with Sleep Impact Category

Age Group	n	Mean SQS	Low (0–25)	Moderate (26–50)	High (51–75)	Severe (76–100)
18–19 yrs	25	34.84	5 (20.0%)	17 (68.0%)	3 (12.0%)	0 (0%)
20–21 yrs	66	39.06	10 (15.2%)	45 (68.2%)	9 (13.6%)	1 (1.5%)
22–23 yrs	9	36.56	1 (11.1%)	8 (88.9%)	0 (0%)	0 (0%)

6. Discussion

The principal finding of this study is that bedtime headphone use is associated with predominantly moderate adverse effects on sleep quality among young adult females, with a mean SQS of 37.78 ± 14.13. The concentration of scores within the Moderate Impact band (70%) is consistent with the broader literature implicating nocturnal electronic media use in disrupting sleep onset and architecture. Pre-sleep auditory engagement is postulated to sustain activity in the reticular activating system, elevate cortical arousal thresholds, and delay transition into the hypnagogic state, thereby increasing sleep onset latency and reducing total sleep time.

The wide standard deviation (14.13) and score range (2–85) suggest that individual-level moderators—such as headphone type (over-ear vs. in-ear), audio content (music vs. speech-based media), volume levels, and duration of use—exert significant influence on the magnitude of sleep disruption. This heterogeneity has important clinical implications: personalised sleep hygiene counselling that accounts for specific usage

patterns is likely to be more efficacious than generic advice.

The heightened vulnerability observed in the 20–21-year cohort (mean SQS: 39.06) may reflect a convergence of factors: intensified academic stress, increased social media and streaming activity, and potentially less-established sleep hygiene practices compared to more senior students. Conversely, the relatively lower disruption observed in the 22–23-year group (36.56) might reflect maturation of self-regulatory behaviours or greater awareness of sleep health, consistent with prior research suggesting that older college students report better sleep hygiene compliance.

Eighteen-year-old participants exhibited the lowest mean SQS (25.44), placing the cohort in the Low Impact category. This finding may reflect the transitional nature of this age group—students newly entering the university environment may not yet have adopted habitual bedtime headphone use to the same degree as their older peers. It must be noted, however, that the 18-year cohort was the smallest (n = 9), limiting the precision of this age-specific estimate.

The 13% prevalence of High Impact and 1% of Severe Impact scores carries meaningful clinical significance. Chronic sleep insufficiency in young women is associated with increased risk of anxiety disorders, depressive symptomatology, immune dysfunction, hormonal dysregulation, and academic underperformance [7]. From a physiotherapy perspective, sleep deprivation also impairs motor learning consolidation, musculoskeletal recovery, and pain modulation—outcomes directly relevant to rehabilitation practice.

In-ear headphone use at bedtime additionally poses mechanical risks: sustained pressure on the external auditory canal may promote impacted cerumen and otitis externa, while sustained high-volume exposure risks cochlear hair-cell damage and NIHL, as documented by Fasanya and Strong (2019) and Muthu et al. (2021) [1, 3]. The present study's findings align with Duggan et al. (2020), who demonstrated that audio environment manipulation (in their case, noise masking) significantly modulates subjective sleep quality among shift workers [7], reinforcing the bidirectional auditory influence on sleep.

These findings collectively support the rejection of the null hypothesis and the acceptance of H_1: bedtime headphone use is significantly associated with adverse sleep quality outcomes in young adult females. Future research employing objective sleep measures (polysomnography, actigraphy) alongside validated subjective instruments (e.g., Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale) and systematic recording of headphone use parameters (duration, volume, content type) would substantially advance causal inference in this domain.

7. Conclusion

This cross-sectional study demonstrates that bedtime headphone use is associated with measurable, predominantly moderate adverse impacts on sleep quality among young adult females aged 18–23 years. With 84% of participants reporting at least moderate-to-severe sleep disruption, the findings underscore a growing public health concern linked to digital media habits in the collegiate female population.

The 20–21-year age cohort exhibits the greatest susceptibility. The wide variability in SQS scores suggests that individual behavioural and contextual factors modulate impact, calling for personalised sleep hygiene counselling. Health educators, physiotherapists, and institutional wellness programmes should promote cessation of headphone use at least 30–60 minutes before bedtime, responsible volume management, and regular listening breaks.

Future research should incorporate objective sleep assessment modalities, larger and more demographically diverse samples, and longitudinal designs to establish directionality and causation.

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