



Prevalence of Social Jet Lag and Associated Sleep and Metabolic Health Risks in a Young Adult Population of Lucknow City of UP State in India

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ABSTRACT

Social jet lag (SJL), defined as the mismatch between biological circadian rhythms and socially imposed schedules, has emerged as an important public health concern among young adults. Persistent circadian misalignment has been associated with sleep disturbances, impaired daytime functioning, and metabolic health risks. This study aimed to assess the prevalence of SJL and its associated sleep and metabolic health outcomes among young adults in Lucknow city. A descriptive cross-sectional study was conducted among 104 adults aged 18–40 years in Lucknow, Uttar Pradesh, India. Data were collected using a structured self-administered questionnaire incorporating demographic details, work schedules, meal patterns, sleep–wake characteristics, and the Munich Chronotype Questionnaire (MCTQ). Sleep parameters on working days and free days were compared using paired t-tests, while associations between SJL and health outcomes were analyzed using chi-square tests and odds ratios. Statistical significance was considered at $p < 0.05$. The majority of participants exhibited an evening chronotype (44.2%), followed by morning (28.8%) and intermediate types (26.9%). SJL was present in 77% of participants. Significant differences were observed between working and free days for sleep duration (5.46 ± 1.36 vs. 8.16 ± 1.47 hours; $p = 0.002$), bedtime ($p = 0.029$), wake-up latency ($p = 0.049$), and sleep latency ($p = 0.019$). Irregular meal timing was reported by 55.77% of participants, while 81.1% experienced work–sleep conflict. SJL was significantly associated with weight gain ($OR = 1.98$; $p = 0.040$) and post-weekend fatigue, irritability, and reduced focus ($OR = 1.76$; $p = 0.041$). In conclusion, social jet lag was highly prevalent among young adults and was significantly associated with sleep disturbances, functional impairment, and early metabolic health risks. Early screening and circadian-aligned lifestyle interventions may help reduce long-term health consequences associated with circadian misalignment.

Keywords: Social jet lag; Circadian rhythm; Sleep disturbances; Chronotype; Young adults; Metabolic health

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INTRODUCTION:

Over the past two centuries, human lifestyles have undergone profound changes due to modernization, including widespread artificial lighting, night-shift work, and rapid travel across time zones.¹ These changes have altered the natural environmental cues that regulate circadian rhythms, the body's internal clock that controls numerous cyclical biological processes essential for health. While technological advancements have increased convenience and access to resources, they have also disrupted natural circadian patterns, particularly in individuals exposed to nighttime work and high-intensity illumination.² This growing circadian misalignment has significant implications for sleep and metabolic health, highlighting

the need to better understand its effects and associated health risks. These advancements have also contributed to the emergence of a widespread form of circadian disruption known as Social Jetlag (SJL), which refers to the chronic mismatch between an individual's internal biological clock, chronotype, and socially imposed schedules such as school or work timing.^{1,3}

Social jetlag is increasingly recognized as an important public health concern. Estimates suggest that a large proportion of the studying and working population in industrialized nations experiences at least one hour of circadian misalignment, while nearly half experience discrepancies of two hours or more.¹⁻³ This condition is not merely a lifestyle inconvenience but a form of physiological conflict resulting

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from differences between biological and social timing. The circadian system regulates several behavioral and physiological functions, including sleep–wake cycles, body temperature, hormonal secretion, and metabolism.¹ When social demands require individuals to wake earlier than their biological preference, persistent circadian misalignment may occur, contributing to sleep disturbances and metabolic dysregulation.

One of the major consequences of social jetlag is the development of disrupted sleep patterns and reduced sleep quality. Individuals often accumulate sleep debt during working days and attempt to compensate through extended sleep on free days, resulting in irregular sleep schedules and circadian instability.^{2,4} Such disturbances may lead to persistent fatigue, poor concentration, mood changes, and impaired daytime functioning. Previous studies have also demonstrated that social jetlag is associated with obesity, metabolic syndrome, cardiovascular risk, and unhealthy lifestyle behaviors, including irregular meal timing and weight gain.^{4,6}

Young adults and adolescents are particularly vulnerable to social jetlag due to a natural tendency toward delayed sleep preference combined with early academic and occupational schedules.^{6,7} Sleep disturbances during this period may persist into adulthood and contribute to long-term health consequences. Despite growing evidence regarding the health effects of social jetlag, variations in its prevalence and associated sleep and metabolic outcomes among young adults remain an area of ongoing investigation.^{1,5–7} As highlighted by Dwivedi A. 2023, approximately, 63% of adolescents were reported to experience social jetlag.⁷

The increasing recognition of social jetlag as a contributor to sleep and metabolic health disturbances emphasizes the importance of screening for early identification of at-risk individuals.⁸ Since circadian misalignment often remains unnoticed until functional impairments develop, assessment of sleep–wake patterns and chronotype distribution may help identify individuals vulnerable to long-term health risks.

The present study aimed to assess the prevalence of SJL and its associated sleep and metabolic health risks among young adults aged 18–40 years. The objectives of the study were to evaluate chronotype distribution and sleep–wake characteristics among the participants, assess the association of SJL with sleep disturbances, mood changes, concentration difficulties, and work–sleep conflict, and examine its relationship with metabolic health-related factors such as irregular meal patterns, weight gain. The study also sought to identify the public health significance of circadian misalignment in young adults.

MATERIALS AND METHODS

Participant Recruitment

This descriptive cross-sectional study was conducted in Lucknow city, Uttar Pradesh, India, using a random sampling technique. The study included young adults aged 18–40 years, comprising university students, working professionals, unemployed individuals, and others. Participants were eligible if they were residents of Lucknow, aged 18–40 years, experiencing partial or complete social jet lag, and able to independently read, respond, and provide informed consent. Individuals outside the target age range, those with highly flexible

work schedules, strictly regulated routines (such as early risers), or retired individuals were excluded from the study.

Data Collection

Data were collected using a structured, self-administered questionnaire designed to obtain comprehensive information on demographic characteristics (age, gender, occupation, height, weight), work and social schedules (working hours, early wake-up due to occupational or academic commitments, sleep deprivation, and physical activity), meal timing patterns (breakfast, lunch, and dinner timings), and sleep–wake behavior (bedtime, wake-up time, sleep duration, alertness periods, and routine sleep patterns). Chronotype was assessed using the Munich Chronotype Questionnaire (MCTQ).

Statistical Analysis and Ethical Considerations

All data were analyzed using IBM SPSS Statistics software. Continuous variables were expressed as mean $\pm$ standard error, while categorical variables were presented as frequencies and percentages. Paired t-tests were used to compare sleep–wake parameters between working and free days, and associations between categorical variables were assessed using the Chi-square test. A *p*-value of <0.05 was considered statistically significant. The study was approved by the Institute and was conducted in accordance with the Declaration of Helsinki. Participants were provided with information sheets in English and Hindi explaining the study purpose and procedures, and written informed consent was obtained before participation. Confidentiality and anonymity of all participant data were strictly maintained throughout the study.

RESULTS

A. Demographic & Baseline Characteristics

A total of 104 participants were enrolled in the study. The majority of the sample were females (73.1%), with males comprising 26.9% of the population, with a mean age of 22.89 ± 4.27 years. Regarding educational attainment, 60.6% of participants were undergraduates, 29.8% were postgraduates, and 9.6% were classified as other. (Table 1A, 1B)

With respect to occupation, students represented the largest subgroup (75.0%), followed by employed individuals (23.1%) and housewives (1.9%). (Table 1A) The mean height was 163.85 ± 45.63 cm and the mean weight was 55.54 ± 10.93 kg. (Table 1B)

Table 1: Demographic, baseline anthropometric and work/study schedule of the study participants.

1A. Demographic Characteristics (N=104)		
Variable	Category	Percent (%)
Gender	Female	73.1
	Male	26.9
Current Study Level	Undergraduate	60.6
	Postgraduate	29.8
	Other	9.6

Occupation	Student	75.0
	Job	23.1
	Housewife	1.9
1B. Baseline Anthropometric Characteristics (N=104)		
Variable	Mean $\pm$ SD	
Age (years)	22.89 $\pm$ 4.27	
Height (cm)	163.85 $\pm$ 45.63	
Weight (kg)	55.54 $\pm$ 10.93	

Values represent percentage and Mean $\pm$ SD of the study population.

B. Meal Patterns and Timings

The distribution of meal timing patterns among participants is presented in the Table below. (Table 2) Most participants consumed breakfast between 7–9 AM (56.73%), while smaller proportions reported eating after 9 AM (23.08%) or before 7 AM (8.65%). A notable 11.54% of participants reported skipping breakfast. For lunch timing, the majority of participants reported consuming lunch between 1–2 PM (70.19%), followed by those eating before 1 PM (17.31%) and after 2 PM (12.50%).

We observed that the dinner timing was predominantly clustered between 8–10 PM (80.77%), while fewer participants reported eating after 10 PM (12.50%) or before 8 PM (5.77%). Late-night eating was rare (0.96%). Regarding regularity of meal timing, we found that slightly more than half of the participants (55.77%) reported consuming meals at irregular times, while 44.23% maintained regular meal timing.

Table 2: Different meal timings in the study participants. (N=104)

Variable	Category	Percentage (%)
Breakfast Time	Before 7 AM	8.65
	7–9 AM	56.73
	After 9 AM	23.08
	Skip	11.54
Lunch Time	Before 1 PM	17.31
	1–2 PM	70.19
	After 2 PM	12.50
Dinner Time	Before 8 PM	5.77
	8–10 PM	80.77
	After 10 PM	12.50
	Late night meals	0.96
Meals at Irregular Times	No	44.23
	Yes	55.77

C. Work Schedule, Sleep Patterns, and Associated Health and Functional Outcomes

As highlighted in Table 3, we observed that the majority of participants were students following a student work schedule (61.5%), while a smaller proportion were engaged in day shifts (23.1%), with fewer participants reporting other schedules (6.7%), rotational shifts (4.8%), and night shifts (3.8%). We found that most participants worked 6–8

hours per day (37.5%) or 8 hours (28.8%), whereas 19.2% worked 6 hours, 13.5% worked more than 8 hours, and only a small fraction (1.0%) reported 7–8 hours.

It was demonstrated that work commitments frequently influenced sleep behavior, as 63.5% of participants reported that they were required to wake up early due to work obligations. In addition, sleep deprivation on working days was commonly reported as sometimes (74.04%), followed by often (15.38%), always (8.65%), and never (1.92%).

We further observed notable associations with health and functional outcomes. Poor concentration (71.6%), mood disturbance (63.2%), and reduced work efficiency (71.6%) were commonly reported among participants. Weight gain was reported by 36.8% of respondents.

We also found a high prevalence of work–sleep conflict (81.1%) and observed that most participants (90.5%) were aware of differences in sleep timing between working and free days. Additionally, 75.8% reported experiencing weekend sleep debt effects.

Table 3: Distribution of work schedule, sleep patterns, and associated health and functional outcomes among participants. (N=104)

Variable	Category	Percent (%)
Type of Work Schedule	Student Work Schedule	61.5
	Day Shift	23.1
	Other	6.7
	Rotational Shift	4.8
	Night Shift	3.8
Total Working Hours per Day	6 hours	19.2
	6–8 hours	37.5
	7–8 hours	1.0
	8 hours	28.8
	More than 8 hours	13.5
Work Commitments Force Early Wakeup	Yes	63.5
	No	36.5
Sleep Deprivation on Working Days	Always	8.65
	Never	1.92
	Often	15.38
	Sometimes	74.04
Poor Concentration	Yes	71.6
	No	28.4
Mood Disturbance	Yes	63.2
	No	36.8
Reduced Work Efficiency	Yes	71.6
	No	28.4
Weight Gain	Yes	36.8
	No	63.2
Work–Sleep Conflict	Yes	81.1
	No	18.9
Sleep Timing Difference Awareness	Yes	90.5
	No	9.5
Weekend Sleep Debt Effect	Yes	75.8
	No	24.2

D. Sleep parameters on Working and Free Days based on Munich Chronotype Questionnaire (MCTQ)

We observed significant differences in several sleep parameters between working days (WD) and free days (FD) based on MCTQ data. Sleep duration was found to differ significantly between working and free days (WD: 5.46 ± 1.36 hours; FD: 8.16 ± 1.47 hours; $p = 0.002$). (Table 4)

Wake-up latency also showed a significant difference between working and free days (WD: 13.19 ± 9.30 minutes; FD: 12.09 ± 8.07 minutes; $p = 0.049$). Similarly, bedtime differed significantly between the two conditions (WD: $23:30 \pm 1:30$; FD: $00:34 \pm 2:15$; $p = 0.029$), as did sleep latency (WD: 25.08 ± 32.28 minutes; FD: 17.24 ± 16.03 minutes; $p = 0.019$). No significant differences were observed for get-up time ($p = 0.338$), fully awake time ($p = 0.237$), energy dip time ($p = 0.900$), and light exposure duration ($p = 0.966$). (Table 4)

Table 4: Comparison of sleep parameters between working days and free days based on MCTQ data. (N=104)

Variable (MCTQ-based)	WD Mean $\pm$ SE	FD Mean $\pm$ SE	<i>p</i> -value
Sleep duration (hrs.)	5.46 ± 1.36	8.16 ± 1.47	0.002*
Get-up time (hh:mm)	$7:06 \pm 1:63$	$9:21 \pm 2:14$	0.338
Wake-up latency (min)	13.19 ± 9.30	12.09 ± 8.07	0.049*
Fully awake time (hh:mm)	$7:41 \pm 1:51$	$9:50 \pm 2:68$	0.237
Energy dip time (hh:mm)	$16:40 \pm 4:05$	$16:27 \pm 5:35$	0.900
Bedtime (hh:mm)	$23:30 \pm 1:30$	$00:34 \pm 2:15$	0.029*
Sleep latency (min)	25.08 ± 32.28	17.24 ± 16.03	0.019*
Light exposure (hrs.)	2.85 ± 2.74	2.80 ± 2.36	0.966

Values Represent Mean $\pm$ Standard Error (SE) for the study participants (n=104).

*Represent a significant *p*-value at $p < 0.05$.

E. Social Jetlag and Chronotype

We found that the largest proportion of participants belonged to the evening type (44.2%), followed by the morning type (28.8%), and the intermediate type (26.9%). (Figure 1) SJL was calculated as the absolute difference between mid-sleep on free days (MSF) and mid-sleep on workdays (MSW), using the formula $SJL = |MSF - MSW|$. Mid-sleep values were obtained by adding half of the sleep duration to sleep onset time after converting clock times into decimal hours, with post-midnight times adjusted accordingly. Participants were classified as having social jet lag, if SJL exceeded 2 hours, and as not having SJL if it was ≤ 2 hours. A high prevalence of SJL was observed among participants, with 77% reporting its presence, while 23% reported no SJL. (Figure 2)

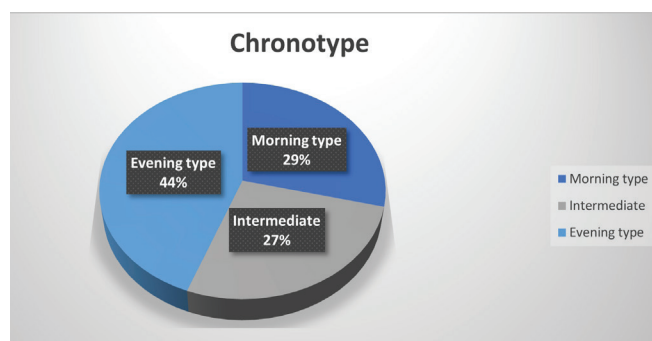


Figure 1: Graphical representation of chronotype distribution among the study participants.

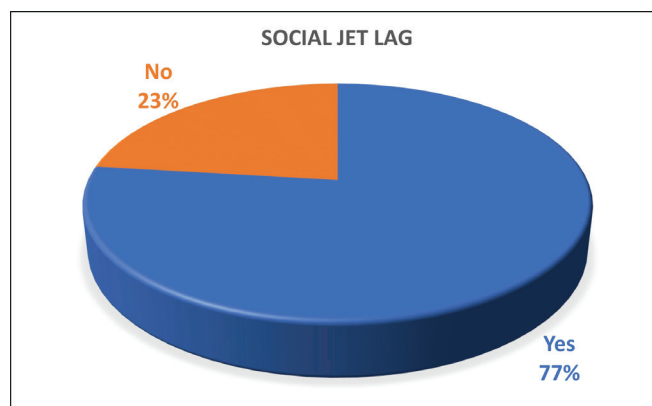


Figure 2: Distribution of Social Jetlag among the Study Participants.

F. Sleep Timing Difference, BMI, Weight Gain, and Post-Weekend Fatigue

The association between social jet lag and selected outcomes was analyzed using the chi-square test and odds ratio estimates. Social jet lag showed a statistically significant association with weight gain ($\chi^2 = 4.21$, $p = 0.040$; OR = 1.98) and post-weekend fatigue ($\chi^2 = 6.37$, $p = 0.041$; OR = 1.76).

No statistically significant association was observed between social jet lag and sleep timing difference between working and free days greater than two hours ($\chi^2 = 1.12$, $p = 0.29$; OR = 1.44). (Table 5)

Table 5: Association of social jet lag with sleep timing variability and health-related outcomes among study participants. (N=104)

Variable	χ^2 -value	<i>p</i> -value	Odds Ratio (OR)
Weight Gain	4.21	0.040*	1.98
Sleep Timing Difference (>2 hours)	1.12	0.29	1.44
Post-weekend Fatigue (Tired/Irritable/Less Focused)	6.37	0.041*	1.76

*Represent a significant *p*-value at $p < 0.05$.

DISCUSSION

This study assessed the prevalence of SJL and its associated sleep and metabolic health risks among young adults. A high prevalence of SJL was observed, with most participants being female undergraduate students and academically engaged individuals. This demographic pattern aligns with previous studies and reflects the vulnerability of university populations to irregular sleep–wake behaviors due to academic demands, social commitments, and delayed sleep schedules.^{9,10}

Irregular and delayed meal timing patterns were highly prevalent among participants, and more than half reported irregular meal schedules, refer to Table 2. Our findings supported previous evidence suggesting that delayed and inconsistent eating behaviors contribute to circadian disruption and metabolic imbalance. In their study, *Lommi S. et al.* 2024 reported that irregular meal patterns and delayed sleep timing independently predicted adverse metabolic outcomes, while *Yan LM et al.* 2024 demonstrated that delayed meal timing was significantly associated with poorer sleep quality, which reinforces social jet lag and contributes to associated sleep and metabolic health risks in young adults.^{11,12}

Alongside occupational and academic schedules also played a major role, as most participants were students or day-shift workers, and a high prevalence of sleep deprivation on working days, work–sleep conflict, and weekend sleep debt was reported. These findings indicated that externally imposed schedules contribute to chronic sleep deprivation and compensatory sleep extension on free days, which are characteristic features of social jet lag.¹³ Similar patterns have been reported in previous studies among students and young workers, where academic and occupational demands significantly affected sleep regularity and circadian alignment.^{7,13}

Our analysis of MCTQ-based sleep parameters, as given in Table 4, further supported the presence of sleep–wake rhythm disruption in the study population. Sleep duration was significantly shorter on working days compared to free days, indicating compensatory sleep recovery during free days. Significant differences were also found in bedtime, sleep latency, and wake-up latency, whereas parameters such as fully awake time, energy dip time, and light exposure remained relatively stable. These findings were consistent with the physiological characteristics of social jet lag reported in previous literature and suggest disrupted synchronization between internal circadian rhythms and external schedules.^{13–15}

The chronotype distribution in our study revealed a predominance of evening chronotype (Figure 1), which has consistently been associated with delayed sleep timing, irregular lifestyle behaviors, and increased susceptibility to social jet lag.^{13–15,7} Importantly, we found that 77% of participants experienced social jet lag, highlighting its high prevalence in this young adult population. (Figure 2) This substantial degree of circadian misalignment aligns with the findings of a study by *Dwivedi A. et al.* conducted on adolescents, depicting that social and academic obligations frequently conflict with biological sleep preferences in young adults, potentially increasing vulnerability to sleep disturbances and metabolic dysfunction.⁷

We further demonstrated a significant association between social jet lag and selected sleep-related and metabolic outcomes. (Table 5)

Participants with SJL had higher odds of reporting weight gain and post-weekend fatigue, irritability, and reduced focus, suggesting that SJL may contribute to both metabolic and functional impairments. These findings suggest that the impact of SJL may initially manifest through behavioral and functional disturbances before measurable anthropometric changes become apparent. Previous evidence illustrated that social jet lag tends to persist over time as a relatively stable pattern of circadian misalignment, particularly among young adults with evening chronotypes and work- or study-related schedule constraints.¹⁶

Our study demonstrated that SJL was associated with early indicators of sleep and metabolic health disturbances, supporting its role as an important public health concern among young adults. Overall, our findings emphasized the importance of early identification of circadian misalignment and promotion of sleep hygiene, regular meal timing, and circadian-aligned lifestyle behaviors to reduce potential long-term health risks associated with SJL.

Limitations: The study was limited by its relatively small sample size, affecting generalizability. Its cross-sectional design prevented causal interpretation of associations. Additionally, data were self-reported, and objective sleep assessment methods were not used.

CONCLUSION

We concluded that social jet lag was highly prevalent among young adults and served as an important indicator of sleep disturbances and early health risks. It was associated with functional impairments such as post-weekend fatigue and showed links with early metabolic changes like weight gain, highlighting its relevance in identifying circadian misalignment-related health consequences. Social jet lag remains a useful public health marker for detecting sleep–wake disruption and potential lifestyle-related health risks in young adults.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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