Evaluation Of Prevalence Of Daytime Sleepiness And Its Association With Chronotype In Undergraduate Medical And Paramedical Students

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Abstract: Background: Daytime sleepiness is a leading cause of impaired academic performance in college students. Disturbed nocturnal sleep and irregular sleep-wake cycle are important causes of excessive daytime sleepiness. Chronotype is the behavioural manifestation of intrinsic circadian rhythm of an organism, and affects timing of activities that govern its 24-hour sleep-wake cycle. Thus, a survey of prevalence daytime sleepiness among various chronotypes in college students is relevant in the current scenario.Objectives: Evaluation of prevalence of Daytime Sleepiness levels and chronotype in target population. Assessment of association of Daytime Sleepiness levels with chronotype, course, and gender of student Assessment of association of among responses to Morningness-Eveningness Questionnaire and Epworth Sleepiness Scale. Methodology: In this cross-sectional study, questionnaire based survey of 389 undergraduate medical and paramedical students (aged 17 -21 years) was conducted in Ahmedabad, using 1997 version Epworth Sleepiness Scale (ESS) and 2008 version of Morningness-Eveningness Questionnaire Self-Assessment (MEQ-SA). Results : Excessive Daytime Sleepiness (EDS) was prevalent in 27.5% of students, and had significant association with course of student (p=0.028) and chronotype (p=0.003). Majority of those having EDS (69%) were MBBS students. Evening chronotype was significantly associated with EDS (p=0.033) and had highest prevalence of EDS (43%). Non-significant association was found between EDS and gender (p=0.871). Course pursued by student was found to be significantly associated with his/her chronotype (p=0.004). Total scores obtained on MEQ-SA and ESS were significantly associated (p=0.002) and negatively correlated; suggesting that increasing "morningness" score tended to reduce daytime sleepiness score. Conclusions : EDS is prevalent in undergraduate college students, and is significantly associated with course and evening chronotype [Upadhyah D Natl J Integr Res Med, 2019; 10(4):10-17]

Key Words: Daytime Sleepiness, Chronotype, Epworth Sleepiness Scale, Morningness-Eveningness Questionnaire.

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Introduction: Circadian rhythm is a natural, oscillating intrinsic physiological cycle which functions in anticipation of the temporal variations in environment that occur with the 24-hour rotation of Earth [1,2] . Circadian patterns are demonstrable at all hierarchies of organism function, even at the simple molecular processes of the cell [3, 4].

'Chronotype' is the behavioural manifestation of the intrinsic circadian rhythm of an organism. At any given time, different chronotypes exhibit different phases of circadian activity [1, 2]. Chronotype is a potent determinant of timing of nocturnal sleep onset and offset [5], chronology of food intake[6,7], appetite[8] , peak physical performance[9], psychometric alertness, daytime sleepiness level variation[10], core-body temperature changes [12], peak melatonin onset time[13] etc.

Implicit to the modern lifestyle are multiple circadian disruptors like round the clock artificial light exposure, poorly scheduled eating habits, excessive use of electronic gadgets like smart phones and laptops [1, 14, 15]. Thus, discrepancy between a person's circadian rhythm and daily professional schedule is likely. Circadian misalignment can cause many metabolic, behavioural and sleep disorders, one of which is Excessive Daytime Sleepiness (EDS) [1].

Daytime sleepiness impairs cognitive function and adversely affects academic performance in college students [16, 17]. Additionally, college students are also significantly at risk for having daytime sleepiness due to other factors like excessive smart phone usage, pubertal shift in sleep-wake cycle, unhealthy lifestyle habits, propensity to schedule recreational and social activities at night and poor sleep hygiene [17, 18].
In the setting of undergraduate medical course where factors such as rigorous academic demands, physical and emotional stress etc. are rampant, daytime sleepiness emerges as a leading challenge faced by students [19, 20].

Thus there arises a need to evaluate daytime sleepiness prevalence across different chronotypes in a target population of university students.

Methodology: Study was started after taking due permission from Institutional Ethics Committee. In a cross-sectional design, information was collected by surveying students by questionnaire method. Target population was aged 17-25 years and consisted of students pursuing undergraduate medical or paramedical courses.
Students belonging to target population willing to answer the questionnaires were included, while those unable to comprehend questionnaire language were excluded.

1997-version of Epworth Sleepiness Scale (ESS) and the 2008 version of Morningness-Eveningness Questionnaire, Self -Assessment (MEQ-SA) were the tools used.
The ESS is a standardized, validated questionnaire used to grade Average Sleep Propensity (ASP) of a subject across various daytime situations. Those feeling higher daytime sleepiness score higher on the ESS. [21, 22]

MEQ-SA is standardized, validated questionnaire used to typify a person's chronotype as one of five categories – Extremely Morning, Moderately Morning, Intermediate, Moderately Evening and Extremely Evening type. The chronotype as obtained from the MEQ-SA has been correlated with circadian variations and melatonin level peaks as well as diurnal variations in core body temperature. [1, 23]

Investigators approached students in a classroom setting, during working hours of college. Students were given a copy each of the ESS and MEQ-SA and instructed to address them subjectively. No time limit was set for answering them. For every student, his/her response to each of the 8 questions of ESS and the 19 questions on MEQ-SA was recorded in an MS-Excel 2007 spreadsheet.
Responses obtained on the ESS were used to calculate Average Sleep Propensity (ASP) of the student across eight daytime situations. Total score obtained on the ESS was used to categorise the student as having Normal Daytime Sleepiness (NDS) (score ≤10) or Excessive Daytime Sleepiness (EDS) (score ≥11). Total score obtained on MEQ-SA was used to classify the student's chronotype, using pre-validated cut-offs for the 5 chronotypes.

Responses to specific questions on the MEQ-SA and the ESS were analysed to check for statistical association using Trial Version of SPSS 7.0. For data analysis, the 5 chronotypes were condensed into 3 categories, namely- Morning, Intermediate, and evening type. Total ESS score of student and his /her category of daytime sleepiness (EDS/NDS) were analysed with their respective MEQ-SA score, course, chronotype, age and sex to check for association among them. Shapiro-Wilk Test was done to check for normalcy in distribution of data collected. For ESS and MEQ-SA scores we obtained p=0.004 and p=0.000 respectively; and thus rejected the null hypothesis that assumed the normal distribution of ESS and MEQ-SA scores. We thereby used non-parametric Spearman's Rho to check for correlations, Kruskal-Wallis test to check for difference in distribution of data and Pearson's Chi-Square test to assess categorical associations.

Results: Survey was conducted in 400 students and 11 incompletely entered forms were excluded from analysis (N=389). In the sample analysed, 137 were males and 252 were females; of which 231 students were medical students and 158 were paramedical students.

1. ESS Score: Total ESS score was found to range from 0 to 17. ESS score >10 i.e. Excessive Daytime Sleepiness (EDS) was reported in 27.5% of the sample size, while 71.5% of the population had ESS score 1-10 Normal Daytime Sleepiness (NDS), and 1% students scored 0 on ESS. Statistically significant association found between prevalence of excessive daytime sleepiness (EDS) and course. (p=0 .028)

Table 1 : EDS prevalence across courses

Course	EDS Prevalence
MBBS	32.03%
BPT	12.96%
BSc Nursing	27.40%
Optometry	19.35%
Total	27.51%

Statistically significant association was found between prevalence of EDS and MBBS Course(p=0.016) with 69% of those having EDS belonging to MBBS course. Significant positive correlation (p= 0.02, r = +0.118) was found between age and ESS score. While gender(p=0.871) was not associated with EDS prevalence.

Table 2 - ESS scores across different activities

ESS-No.	Activity	Percentage of respondents reporting high daytime sleepiness (score ≥2)	Percentage of Medical Students reporting high daytime sleepiness (score ≥2)	Percentage of Paramedical Students reporting high daytime sleepiness (score ≥2)
ESS1	Reading	35.73%	34.20%	37.97%
ESS2	Watching TV	17.74%	23.38%	9.49%
ESS3	Sitting quietly	15.94%	18.61%	12.03%
ESS4	Car-Passenger	47.56%	48.92%	45.57%
ESS5	Lying down in Afternoon	71.47%	74.46%	67.09%
ESS6	Talking	5.91%	6.06%	5.70%
ESS7	Post-Lunch	48.07%	46.75%	50.00%
ESS8	During traffic	11.31%	11.26%	11.39%

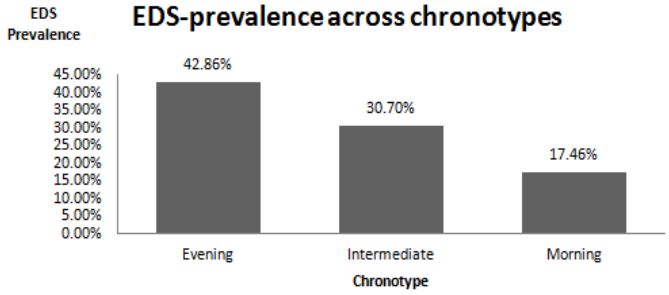
Table 3 - Frequency distribution of MEQ-SA scores obtained

Group	Chronotype	MEQ-SA Score		Total Number of Students	Prevalence in Medical Students	Prevalence in Paramedical Students
1	Definitely Evening Type	16-30		0	0%	0%
2	Moderate Evening Type	31-41		35	12.99%	3.16%
3	Intermediate	42-56		228	61.04%	55.06%
4	Moderate morning Type	59-69		118	24.68%	38.61%
5	Definitely morning Type	70-86		8	1.30%	3.16%
Total				389	100%	100%

2. MEQ-SA Scores: Total MEQ-SA score ranged from 31 to 73. Most of the respondents (58.6%) belonged to Intermediate Chronotype, while 32.4% were from Morning chronotype and 9% belonged to Evening chronotype. Significant association found between chronotype and course (p=0.004) but not with gender (p= 0.386) or age (p=0.911). MBBS course was associated with a lower prevalence of morning chronotype (p=0.001) and higher prevalence of evening chronotype (p=0.001), while reverse was true for Paramedical courses. Prevalence of Intermediate chronotype had no association with course (p=0.663).

3. EDS Prevalence across chronotypes: Significant association found between EDS prevalence and Chronotype (p=0.003). Evening chronotype was found to have higher prevalence of EDS and reverse was true for Morning chronotype (p=0.033). Total scores of MEQ-SA and ESS were found to have statistically significant negative correlation (p=0.002, r= -0.158).

Figure 1- EDS Prevalence across Chronotypes



4. Subjective Identification with a chronotype (MEQ-19): 19th Question of MEQ-SA scored the Subjective identification of self as a particular chronotype, with a score range of 1 to 6. Scores obtained on MEQ19 and total MEQ-SA had a significant positive correlation (p=0.000; r = +0.652). 38.6% Respondents were classified as "identifying themselves as evening type" (score ≤2) while 61.4% were classified as "Identifying themselves as morning type" (score >2)

Self-Identification with a Chronotype was significantly associated with occurrence of EDS

(p=0.003), with a lower prevalence in those identifying themselves as having a morning chronotype (22.18%) as opposed to those identifying themselves as evening chronotype (36%)

5. Post-Lunch Dip (Ess7): 7th question of the ESS scored the average sleep propensity post-lunch, with a score range of 0 to 3. 80.2% of the students surveyed reported feeling sleepy (score ≥1) post lunch. No significant difference was found in distribution of ess7 scores across the chronotypes (p=0.706). No significant association was found between ESS-7 score and total MEQ-SA score (p=0.233) gender (p=0.406) or age (p=0.477). ESS7 scores have a significant strong positive correlation with total ESS score (p= 0.000, r =+0.518), with significant association between prevalence of EDS (p=0.000), and feeling sleepy post-lunch.

6. Alarm-Clock Dependence (MEQ-3): Score obtained on 3rd question of MEQ-SA graded subjective alarm clock dependence, with a score range of 1 to 4. 90% of the students surveyed reported a dependency (score = 4) on alarm clock to be able to wake up in the morning, while no dependency on the alarm clock (score ≤3) was reported in just 10% of the students.

Significant association was found between alarm clock dependence and morning chronotype (p=0.000), intermediate chronotype (p=0.000), but not with evening chronotype (p=0.815), gender (p=0.750), age (p=0.390) or EDS prevalence (p=0.064).MEQ3-score had significant negative correlation with total ESS score (p=0.000, r= -0.189) and significant association and positive correlation with total MEQ-SA score (p= 0.000, r = +.289).

7. Hunger on waking up in the morning (MEQ-6)
Hunger within first half-hour of waking up was graded by 3rdquestion of MEQ-SA, with a score range of 1 to 4.

MEQ-6 score found to have significant positive correlation with total ESS score (p= 0.000, r = +.202), but not with EDS prevalence (p=0.419) or gender (p=0.729). Scores obtained on ESS-7 (scoring ASP post lunch) had significant and positive correlation (p= 0.001; r = +0.164) with MEQ-6 scores. Feeling hungry in the first half hour of waking up in morning (MEQ-6 score >1) was significantly associated with feeling sleepy after lunch (score >0 on Ess-7) (p=0.020), with 64% of the post-lunch dippers reporting feeling hungry on waking up.

MEQ-6 score found to have significant positive correlation with total MEQ-SA score (p= 0.006, r = +0.140). Feeling hunger on waking up (MEQ-6 score ≥2) was significantly associated with morning chronotype (p=0.016) but not with intermediate (p=0.173) or evening chronotype (p=0.114).

Discussion : 1. ESS-Results : EDS was prevalent in 27.5% of the population surveyed. This is less than that reported in undergraduate medical students in western countries and North Indian population [17, 24] but higher than that reported in Central Indian undergraduates [16]. Cultural variations in lifestyle habits thus need to be analysed with respect to daytime sleepiness.

Age was found to be significantly associated and positively correlated with ESS-score, daytime sleepiness increased with an increasing age in our study population. This trend has also been reported in previous studies, and the synaptic re-organisation of the maturing adolescent brain has been implicated in it [25]. Hormonal, social and professional challenges faced by the young adults might also be responsible for the same [17].

Statistically significant association was found between course and EDS prevalence. Students pursuing MBBS formed 69% of the EDS-group. Almost a third of the MBBS students were found to have EDS, with only the MBBS group having a higher than average prevalence of EDS. This difference in EDS-prevalence requires analysis taking into account factors like academic schedules, life-stressors, socio-economic profile, substance abuse patterns etc.

2. MEQ-SA-Results : We found that majority of those surveyed belonged to Intermediate Chronotype (59%). Assuming a constant sleep-wake cycle; this chronotype is most suited to a schedule with a wake-up time between 6.30-8.30am and a sleep-onset time between 10.45-12.45pm [2, 26]. This is consistent with the overall professional and social habits which the target population has.

Intermediate chronotype did not differ in its distribution across any demographic factor. This

reflects its circadian versatility and also offers an explanation regarding its widespread distribution. Morning chronotypes were found to be second most-prevalent (32%). It is associated with a wake-up time of 4am-6.30am and sleep onset between 9pm-10.45pm [2,26]. These are characterised by an earlier bedtime habit, and often find it difficult to stay up late at night. These subjects are often unable to engage in activities such as late night studying, socialising etc.

Moderately Evening chronotype was least prevalent (9%), while no subject having "Extremely Evening" chronotype was reported. Those with evening chronotype have expected sleep onset between 12.45am-2am; and a sleep offset around 8.30am-10am [2, 26]. Thus, the evening chronotype can be stated as to having least compatibility with the schedule followed by target population.

No subject having "extremely evening chronotype was found. That chronotype is suited for night-shift work and unlikely to be compatible for those having daytime professional schedules [27].

Course pursued by student was found to be significantly associated with chronotype, with MBBS being associated with significantly higher prevalence of evening chronotype. Medical students had a lower prevalence of morning chronotype and higher prevalence of evening chronotype, while reverse was true for paramedical courses. Difference in pattern of study habits, different working hours and different social habits are possible causes of this difference [19,20].

3. EDS-across chronotypes: EDS prevalence was highest in the Evening Chronotype, and least in the Morning Chronotype, and increasing "Morningness" trait-score reduced the Daytime Sleepiness levels. Daytime sleepiness is a direct consequence of impaired nocturnal sleep, with higher ESS scores obtained in those having lesser nocturnal sleep time, poor sleep hygiene or quality [24].

It is noteworthy that Horne and colleagues reported no significant difference in total nocturnal sleep length across chronotypes [2]. Later chronotypes are more likely to have to wake up before their natural circadian offset of sleep in order to fulfil their professional and social commitments. This discrepancy between intrinsic rhythm and externally-imposed clock is termed as "social jetlag"; which is responsible for disturbances in sleep, metabolism and behaviour [1]. Morning chronotypes thus have a notable advantage over others while functioning in morning-based routines.

4. Subjective Identification with a chronotype (MEQ-19): Identification of self as Morning or Evening chronotype, as graded by the 19th question of MEQ was found to have strongest correlation with total MEQ-score among all the questions of the MEQ-SA. This question has also been incorporated as one of the five items of the Reduced Morningness-Eveningness Questionnaire (rMEQ), a shortened version of the MEQ that is used measure chronotype [27]. This implies a high-level of self-awareness regarding one's sleep-wake cycle. Self-identification with morningness was strongly associated with Morning Chronotype and thus a lower prevalence of EDS.

5. Post-Lunch Dip (Ess7): Previous studies have documented increased sleep propensity and dip in core body temperature in the mid-afternoon hours. This phenomenon commonly referred to as the "post-lunch dip" and is thought to be caused by having a heavy meal. It has been demonstrated to occur in absence of lunchtime-meal or subjective awareness about time of day. [28] This suggests that the post-lunch dip is partly a circadian phenomenon.

It has been hypothesized that earlier chronotypes are prone to the post-lunch dip, since they have spent more time since sleep by mid-afternoon hours, as compared to later chronotypes [29]. In our study; 80.2% of students felt sleepy in the post-lunch period but their ESS7 score was not differently distributed across chronotypes. There was a significant association between EDS prevalence and occurrence of post lunch dip, with the post-lunch period being one of the most prevalent situations where students reported feeling sleepy.

While the earlier chronotypes might be more prone to having a post lunch dip, we found the later chronotypes to have a comparatively higher prevalence of EDS. Thus the higher sleep propensity due to EDS the Evening Chronotype seems to ameliorate any circadian advantage

they have in the post lunch period. In the given population, high EDS-prevalence in the Evening Chronotype might thus be responsible for non-significant difference in post lunch ASP across chronotypes.

6. Alarm-Clock Dependence (MEQ-3): Zeitgebers are environmental cues that animals use to entrain their sleep-wake cycle to their surroundings. They can be natural, social, or artificial.

90% of students surveyed reported a dependency on their alarm clock to be able to wake up at specific time in the morning. We found higher alarm clock dependence to be associated with earlier chronotypes, having a slightly lower daytime sleepiness score, while not having any association with Excessive daytime sleepiness.
Thereby the alarm clock can be stated to be an important artificial zeitgeber [30], for those having an earlier wake-up time.

7. Hunger on waking up in the morning (MEQ-6)
There occur circadian variations in the intensity of hunger. Studies have documented a circadian peak in hunger at the evening time; this is to prepare the body for a period of overnight fasting [8].
Just before waking up in the morning hunger-levels reach a circadian trough, till the zeitgebers that herald the light phase of an animal's clock signal the onset of food seeking behaviours [1]. Those having a late chronotype are likely to wake up during the period of their 'hunger-trough' and hence have less hunger on waking up in morning.
Feeling hungry on waking up was significantly associated with Morning Chronotypes. Also, positive correlation between MEQ-6 score and total MEQ-SA score indicated that higher hunger in morning tends to an earlier chronotype.

Feeling hunger in the morning was associated with higher ASP post-lunch. We hypothesise that higher hunger in the morning can lead to heavier consumption of calories at lunch time leading to higher level sleepiness post-lunch. Breakfast-skipping has been reported in 71% of adult Indian population [31], and might be the link between higher hunger at morning and higher ASP post lunch. However, further studies taking into account details of chronology of food-intake are required to explain this phenomenon. Our study was not without limitations. Since we had a cross-sectional design, we could assess only the point prevalence of parameters. Also, the MEQ-SA assumes the subjects have a fixed routine throughout the week which may not be true for all. Lastly, recall bias by the subjects cannot be ruled out.

Conclusions: EDS is prevalent in target population and associated with MBBS course, age and Morningness-Eveningness of students but not with gender. Chronotype of student is associated with his/her course, but not with age or gender.

Post-lunch dip is a ubiquitous circadian phenomenon, prevalent in all chronotypes. Subjective identification with a chronotype is an important determinant of an individual's circadian rhythm. The alarm clock is a relevant cue for entrainment of sleep-wake cycle. Feeling hungry on waking up is associated with morning chronotype.

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