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Short Communication

Effect of Nap Behaviour on Neurocognitive Functions among Indian Medical Undergraduates: A Preliminary Report

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ABSTRACT

The understanding of the relationship between napping and cognitive performances among Indian medical undergraduates is not fully elucidated. Therefore, the present study aims to evaluate the effect of napping behavior on neurocognitive performances. Also, to explore the causes behind the napping behavior and its effect on sleep quality and overall well-being among Indian medical undergraduates. A cross-sectional analytical study was carried out at tertiary care at the Department of Physiology, All India Institute of Medical Sciences (AIIMS), Bathinda with a comparison group including a total of ninety-eight (98) right-handed Indian medical undergraduates with and without napping behavior using the Napping Behaviour Questionnaire. Other neuropsychological assessments include the Simple Motor Reaction Time; the Daytime Feelings and Functioning Scale; the Mental Fatigue Scale; Pittsburgh Sleep Quality Index; WHO-5 Well-Being Index. All the above measurements were carried out in the morning session between 9:00 am-11:00 am but Simple Motor Reaction Time (SMRT) was carried out twice i.e., the morning hours (9:00-11:00 am) and the evening hours (9:00-11:00 pm) to assess and compare the cognitive performance during these timings. From the present study, the nappers showed a significant ($p<0.05$) decrease in the evening hours reaction time compared to morning hours. Importantly, it was observed that as the duration of napping increased, the sleep quality statistically ($r=0.226$; $p=0.038$) was found to decrease. However, we didn't find a significant difference between nappers *vs.* non-nappers for the subcomponents analysis of sleep quality. A very interesting significant ($p<0.05$) correlation was also observed between the well-being scores with the daytime feelings and functioning scores, sleep quality and the mental fatigue scores among the nappers' group. The present findings concluded that a shorter duration of naps may be a possible 'public health tool' for better sleep quality that further enhances cognitive processing. Also, simple motor reaction time and sleep quality index may be used as a screening tool for the early detection of cognitive impairment associated with napping behavior among medical undergraduates.

Keywords: Cognitive assessment, Mental fatigue, Napping behaviour, Neurotoxic, Simple motor reaction time, Sleep quality.

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INTRODUCTION

Naps are short periods of sleep especially during the daytime and are seen as a part of daily routine for many people.[1] Various reasons lead to napping behavior such as in response to sleep loss referred to as 'replacement napping' or as preparation for sleep loss i.e., 'prophylactic napping'. Some might just simply enjoy naps called 'appetitive napping'.[1,2]

The optimal sleep duration for survival is 6.0-7.0 hr/night. It has been reported that short and long sleep durations increase mortality in most populations.[2,3] Studies have shown several advantages of napping, including creating alertness, promoting homeostasis and improving day-to-day performances by enhancing the immune system.[4-6] Also, behavioral improvements include good mood and reduced sleepiness.[4,5] On the other hand, few studies have shown negative aspects of napping behavior, including decreased productivity at work, high morbidity, dementia, reduced social interactions, depressed mood and increased risk for hypertension.[7-13] However, these concomitant results on napping due to methodological constraints[11] such as

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study population, napping duration, study design methodologies, napping behaviors, daytime activity levels across studies, etc.

Now, the question arises whether naps are helpful and should be inculcated in daily routines to improve cognitive performance. To date, no literature from India has shown whether naps are beneficial or not. Also, previous studies have not explored the association between nap behavior and reaction times. Therefore, the present study has been designed to evaluate nap behavior among Indian medical undergraduate college students. Also, to assess napping's association with sleep quality, reaction times and overall well-being.

MATERIALS AND METHODS

The present study was a cross-sectional analytical study with a comparison group including ninety-eight (98) right-handed healthy undergraduate medical college students studying in tertiary care at the Department of Physiology, All India Institute of Medical Sciences (AIIMS), Bathinda (Punjab); aged (18-25 years) including both male and female. The students with a known history of sleep disorders, drugs interfering with sleep patterns and substance abuse were excluded from the study. The study was conducted from 1st December 2023 to 1st February 2024 (2 months of the study period for the undergraduate ICMR, New Delhi- STS project 2023; Ref. No.2023-04779) in the Department of Physiology at AIIMS, Bathinda. The study design and recruitment flow diagram are shown in Figure 1. The present study was conducted per the Helsinki Declaration and was approved by the Institutional Ethics Committee (IEC) (Ref. No.: IEC/AIIMS/BTI/416). All patients provided their informed consent. The sample size for the study was calculated using *n-master* version 2.0[14] software, assuming the prevalence of napping among college students is 53.6% 9 and 95% confidence interval with an absolute precision of 10%, which came out to be ninety-eight (98).

Neurocognitive Assessment Tools

All undergraduate medical students underwent cognitive assessment using the English and Hindi versions of all questionnaires used in the present study. Both instruments were valid and reliable among Indians by taking cultural and linguistic differences into account.[6] All the questionnaires were filled during morning hours, i.e., between 9:00 am-11:00 am within 10-15 min, respectively, by the student under the supervision of expert clinicians, but Simple Motor Reaction Time (SMRT) was carried out both morning and evening hours.

The following standardized questionnaires and cognitive tools were used to assess the napping behavior among medical students:

Napping Behaviour Questionnaire (NBQ)

It is a 6-item napping behavior questionnaire about napping, including frequency, duration, time of day when any naps are taken and the reason for napping.[9]

Simple Motor Reaction Time (SMRT)

Simple Reaction Time (SRT) is a computer-assisted reaction test of Human Benchmark, designed to evaluate the reaction time to frontal visual stimuli. The testing was carried out with dominant and non-dominant hands, five executions for each hand/2 trials. We considered the average reaction time for the best trial result in milliseconds (ms).[15]

Daytime Feelings and Functioning Scale (DFFS)

The Daytime Feelings and Functioning Scale (DFFS) is a questionnaire assessing various daytime functioning aspects. It consists of 12 items that capture feelings and behaviors related to how well an individual functions during the day. The score range is 0-36, with higher scores indicating greater daytime impairment.[16]

Mental Fatigue Scale (MFS)

The MFS consists of 15 questions targeting different symptoms of mental fatigue, including affective, cognitive and sensory symptoms, duration of sleep and daytime variation in symptom severity (during common activities). Each item has 4 response options: 0 corresponds to normal function, 1 indicates a problem, 2 is a pronounced symptom and 3 is a maximal symptom. Selecting a rating between 2 response options (i.e. 1.5, 2.5, etc.) is also possible. Items 1-14 are used to calculate the total score, whereas item 15 provides additional information on daytime variation of symptoms. A total score ≥10.5 indicates fatigue.[17]

Pittsburgh Sleep Quality Index (PSQI)

A self-report questionnaire assesses sleep quality over a 1-month interval. It is intended to be a standardized sleep questionnaire for clinicians and researchers to use easily and has been used to diagnose sleep disorders. The global PSQI score is then calculated by totaling the 7 component scores, providing an overall score ranging from 0 to 21, where lower scores denote a healthier sleep quality.[18]

Well-being index (WHO-5)-5 items

It is a valuable measure of general well-being. Its simplicity and effectiveness make it a valuable resource for evaluating subjective psychological well-being. The raw scores range from 0-25; '0' represents the worst possible and '25' represents the best possible quality of life.[19]

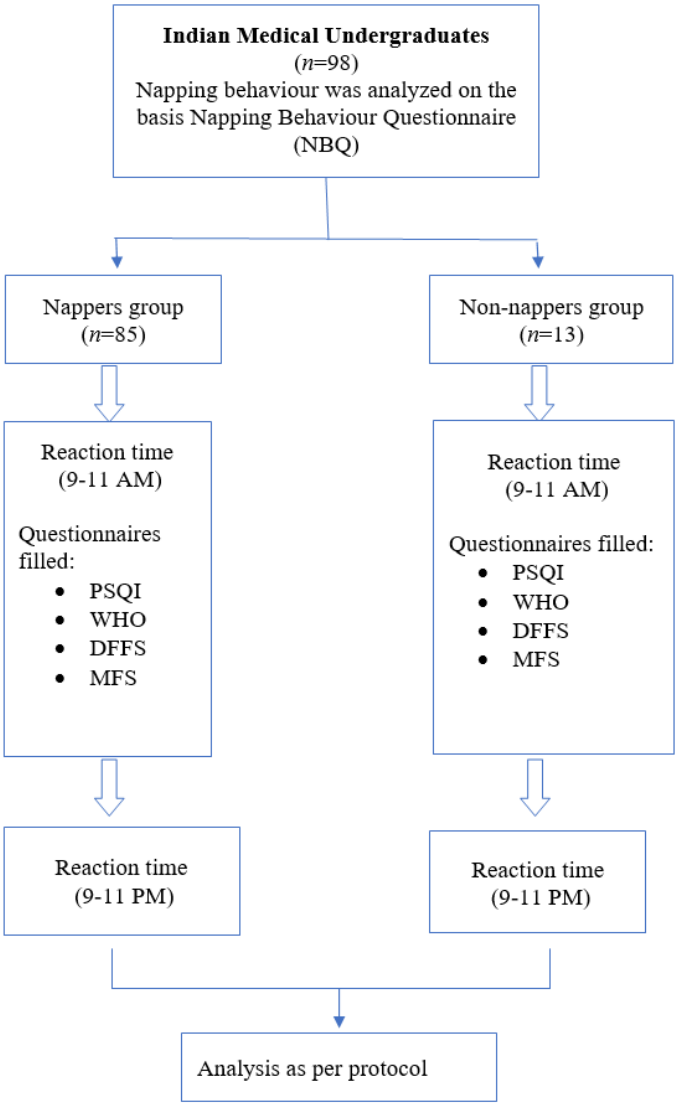

Figure 1: Flow diagram showing the Study Design.

PSQI: Pittsburgh Sleep Quality Index; WHO: WHO Well Being Index; DFFS: Daytime feelings and functioning Scale; MFS: Mental Fatigue Scale.

Statistical Analysis of Data

The statistical analysis of research data is carried out using SPSS software Version 20.0 (IBM, Chicago, Illinois, United States of America, October 2020). Research data is represented as mean±standard deviation, median (range) and percentages. An independent *'t-test'* is done to compare the variables between nappers *vs.* non-nappers groups. Student paired *'t'* test compares the morning *vs.* evening hours of napping effect among nappers groups. The chi-square test is carried out for categorical differences between genders. Pearson's correlation coefficient is used to find an association between variables such as napping duration, reaction time, well-being scores, sleep scores and mental fatigue. Significance was accepted at $p<0.05$.

The study was conducted under the Declaration of Helsinki and was approved by the appropriate local ethics committee and Institutional Review Board (Ref. No.: IEC/AIIMS/BTI/416). All patients provided their informed consent.

RESULTS

The present study assessed the effect of Nap Behaviour among Indian Medical Graduates studying at All India Institute of Medical Sciences, Bathinda, between 1st December 2023 to 1st February 2024. The students were asked to fill out the napping behavior questionnaires such as NBQs, PSQI, MFS, DFFS and WHO well-being questionnaires and reaction times morning and evening. Firstly, the students were asked to fill out the Napping behavior questionnaire. Out of ninety-eight (98), eighty-five (85;

Table 1: Demographic and Napping Behavioural Questionnaires for Nappers Group *vs.* Non-Nappers Group.

Demographic parameters and Variables	Nappers Group (NG) (Mean±SD)	Non-nappers Group (NNG) Median (range)	*p*-value
Number of participants (*n*)	85	13	-
Gender *n* (%)	F: 46 (47.9)M :39 (39.7)	F: 7 (7.1)M: 6 (6.1)	0.04*(5.99)
Age(years)	19.45±1.19	20.0 (18.0-21.0)	0.70
Napping Behaviour Questionnaires			
Pittsburgh Sleep Quality Index(PSQI).	5.23±2.56	4.0 (1.0-9.0)	0.26
WHO Well Being Index (WHO).	16.11±4.10	16.0 (11.0-24.0)	0.68
Daytime feelings and functioning Scale (DFFS).	10.63±4.70	11.0 (4.0-16.0)	0.53
Mental Fatigue Scale(MFS).	9.18±4.50	9.0 (2.50-14.0)	0.61

All the values are in mean±SD for napper's group and the median (range) for the non-nappers group; significance at $p<0.05$.Kolmogorov-Smirnov test was carried out to test the normality of data.Independent *t*-test between two independent groups i.e., Nappers vs. No-nappers.*Chi-square test for categorical differences with significance $p<0.05$.

Table 2: Reaction Time (RT) among Napper's Group *vs.* Non-Napper's Group.

	Napper's Group (NG)	Non-Nappers Group (NNG)	*p*-value
Reaction Time (Morning hours)	331.44±58.01	284.0 (207.0-413.0)	0.18
Reaction Time (Evening Hours)	317.78±47.93	266.0 (214.0-409.0)	0.13

All the values are in mean±SD for napper's group and the Interquartile Range (IQR) range for the non-nappers group; significance at $p<0.05$.Independent *t*-test between 2 independent groups i.e., Nappers vs. No-nappers.

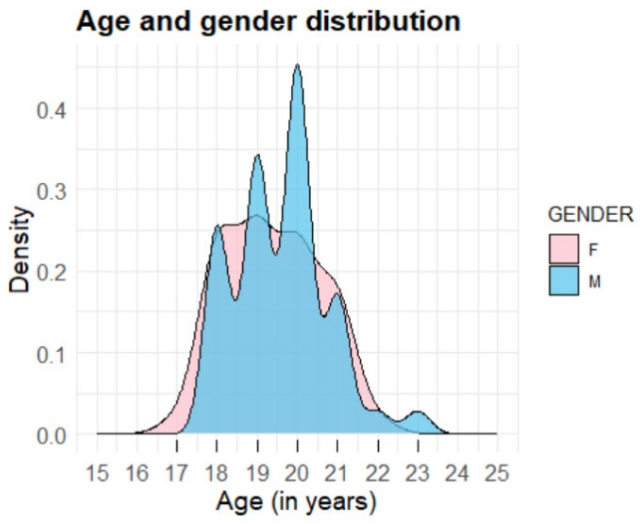

Figure 2: Age and Gender distribution of the subjects (Indian Medical Undergraduates).

46F, 39M) undergraduate students were reported to be nappers and the remaining thirteen (13; 7F, 6M) were reported to be non-nappers. The study design and recruitment flow diagram are shown in Figure 1. The mean age for nappers was reported to be 19.45±1.19 years and the mean age for non-nappers was reported to be 19.53±1.05 years (Figure 2; Table 1). The age difference was not found to be statistically significant.

From the present study, among the nappers group *vs.* non-nappers group, statistical significance (p=0.53) was not observed in the scores for sleep quality, mental fatigue, well-being, daytime feelings and functioning activities (Table 1).

The reaction time was calculated using Human Benchmark Online Software twice i.e., in the morning hours (9:00-11:00 am) and the evening hours (9:00-11:00 pm) to assess the cognitive ability to detect, process and respond to a stimulus. The difference in morning and evening reaction times was insignificant between nappers and non-nappers (Table 2). Importantly, the difference in the morning *vs.* evening reaction times among the nappers was observed as statistically significant (p=0.006) i.e., reaction time after napping during evening hours was found to be significantly decreased when compared to morning hours reaction time (Table 3).

Further, each component of napping behavior was analyzed (Napping Behaviour Questionnaire) among undergraduates in detail in terms of duration, types and cause of napping behavior. It was found that out of ninety-eight (98), eighty-five (85) undergraduates were found to be nappers. In comparison, the rest of the thirteen (13) undergraduates were non-nappers (Figure 3). It has been observed that most of the students reported napping 3-4 days a week (Figure 4a) which was either planned or spontaneous (Figure 4b) and mostly the naps ended

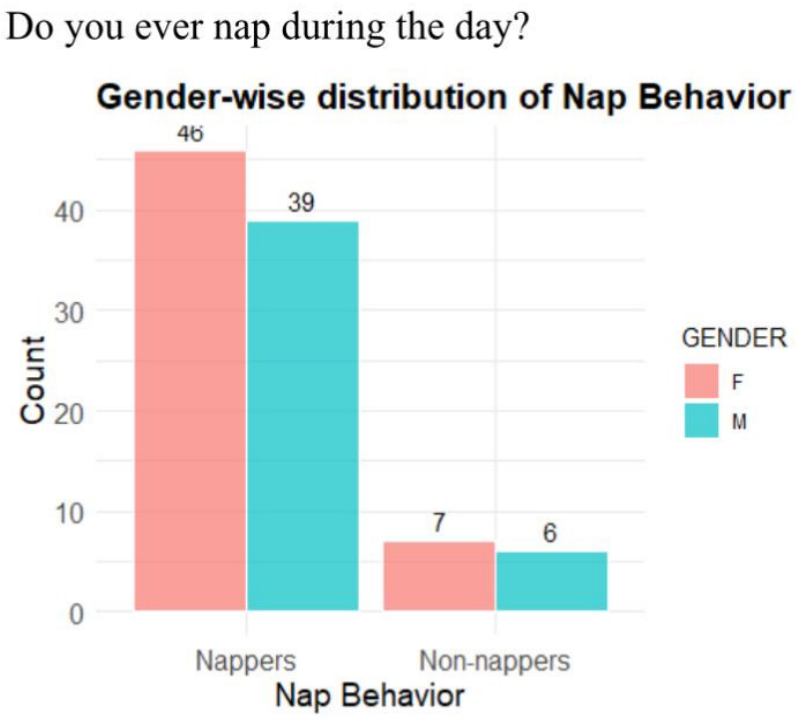

Figure 3: Gender-wise distribution of nap behavior among Indian Medical Undergraduates.

Table 3: **Reaction time Morning *vs.* Evening Hours among Napper's Group and Non-napper's Group.**

	Reaction Time (Morning Hours)	Reaction Time (Evening Hours)	*p*-value
Napper's Group (NG)	331.44±58.01	317.78±47.93	0.006
Non-Napper's Group (NNG)	284.0 (207.0-413.0)	266.0 (214.0-409.0)	0.18

All the values are in mean±SD for the napper's group and the Interquartile Range (IQR) range for the non-nappers group; significance at $p<0.05$.Student paired *t*-test between two independent groups i.e., Nappers *vs.* No-nappers.*Chi-square Test for categorical differences with significance $p<0.05$.

Table 4: **Subcomponents analysis for PSQI questionnaire among Napper's Group *vs.* Non-napper's Group.**

	Nappers Group (NG) (Mean±SD)	Non-Nappers Group (NNG) Median (range)	*p*-value
Component-1(Subjective sleep Quality)	0.92±0.61	1.00 (0.00-1.00)	0.18
Component-2(Sleep latency)	0.94±0.93	1.00 (0.00-3.00)	0.83
Component-3(Sleep duration)	1.22±0.82	1.00 (0.00-2.00)	0.04
Component-4(Sleep Efficiency)	0.27±0.67	0.00 (0.00-2.00)	0.84
Component-5(Sleep disturbance)	0.82±0.49	1.00 (0.00-1.00)	0.37
Component-6(Use of sleep medication)	0.05±0.28	0.00 (0.00-0.00)	0.06
Component-7(Daytime dysfunction)	1.01±0.60	1.00 (0.00-1.00)	0.19

All the values are in mean±SD for the napper's group and the median (range) for the non-nappers group; significance at $p<0.05$.Independent *t*-test between two independent groups i.e., Nappers vs. No-nappers.

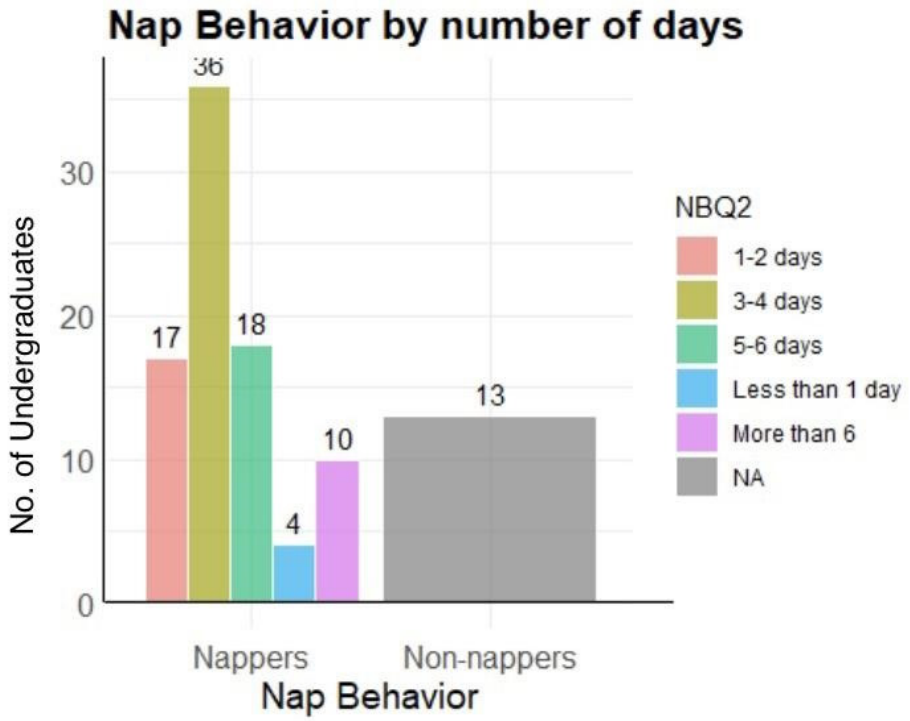

Figure 4a: Nap behavior by number of days among the nappers using NBQs.

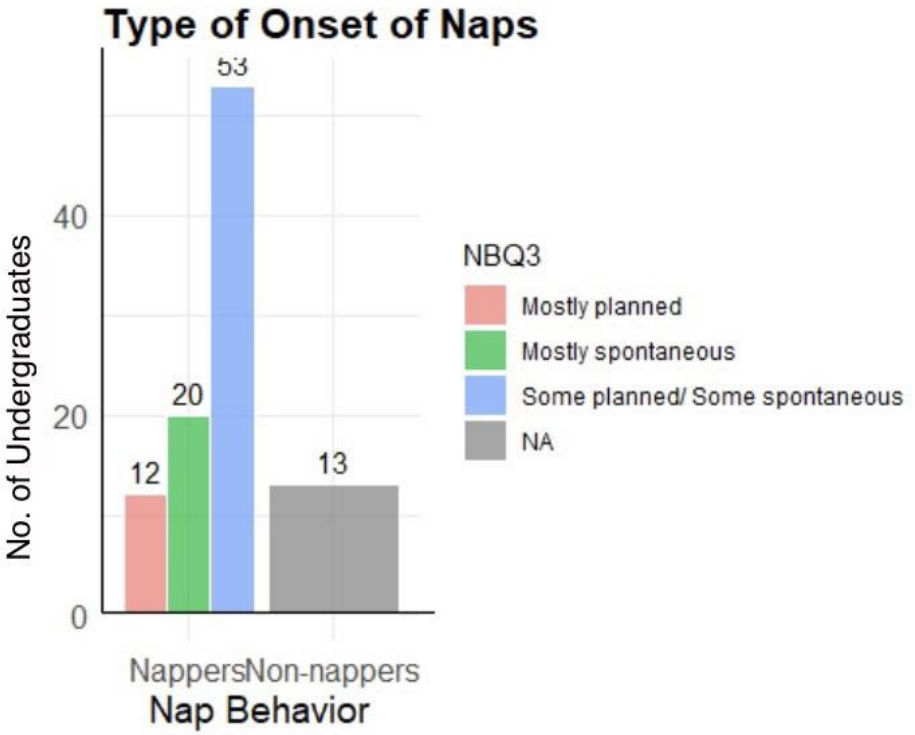

Figure 4b: Type of onset of the naps among medical students using NBQs.

with the aid of alarms (Figure 4c). For the duration of nap, 25 students reported having naps of more than 60 min, 21 reported to have naps 35-45 min long while 20 students reported to have naps 45-60 min long (Figure 4d). Majority of students usually had their naps between 5:00-7:00 pm, which is after the college hours (Figure 4e) and most of the students felt refreshed after the naps (Figure 4f) with the adequacy of nighttime sleep (Figure 4g).

On the other hand, we assessed the duration of napping among the napper's group and a very interesting correlation was observed between 'nap duration' and the 'sleep quality index'. As the duration of napping increased, the sleep quality statistically (r=0.226; p=0.038) was found to decrease (Figure 5). This means that shorter naps are beneficial for better sleep quality and enhanced cognitive processing. We also assessed the subcomponents analysis of the Sleep Quality Index (PSQI) questionnaire to determine the sleep quality among nappers and non-nappers, but we didn't find any statistical significance between groups (Table 4).

A very interesting correlation was also observed between the (WHO) well-being scores with the Daytime Feelings and Functioning Scale (DFFS) [r=-0.488, p=0.001], Pittsburgh Sleep Quality Index (PSQI) [r=-0.371, p=0.001s] and the Mental Fatigue Scale (MFS) [r=-0.559, p=0.001] (Figures 6-8) among the nappers' group. This means mental fatigue and daytime feeling sleep scores are highly affected by the well-being of the nappers. Though we didn't find any significant results between WHO well-being scores among nappers *vs.* non-nappers, we have tried to find the correlation between WHO scores with all these questionnaires for the napper's group to check their well-being status with their mental fatigue, as their reaction time found to be decreased following napping; which will also confirm the findings of getting reduced reaction time following napping.

DISCUSSION

The present study assessed napping behavior among Indian medical undergraduates for the first time in India using scientific evidence. As per the study findings, these undergraduate medical students napped at least 3-4 days a week and the duration of naps varied mostly from 15 min to 60 min. They occurred spontaneously, mostly during evening hours, i.e., between 5-7 pm, the period after the lectures, i.e., after 5 pm.

To evaluate daytime *vs.* evening hours napping on psycho-cognitive behavior, we assessed the Simple motor Reaction Time (SRT) at 2 intervals i.e., 9:00-11:00 am and 9:00-11:00 pm among nappers and non-nappers groups using the Human Benchmark Online Software. We observed a significant decrease in reaction time for the evening hours *vs.* morning hours among the nappers group but didn't find any significant difference between the nappers group *vs.* the non-nappers group. From the present findings, the reduced reaction time after evening napping enhances the brain's cognitive processing ability to analyze, transform, store and recover information after responding to a specific signal.[20] This

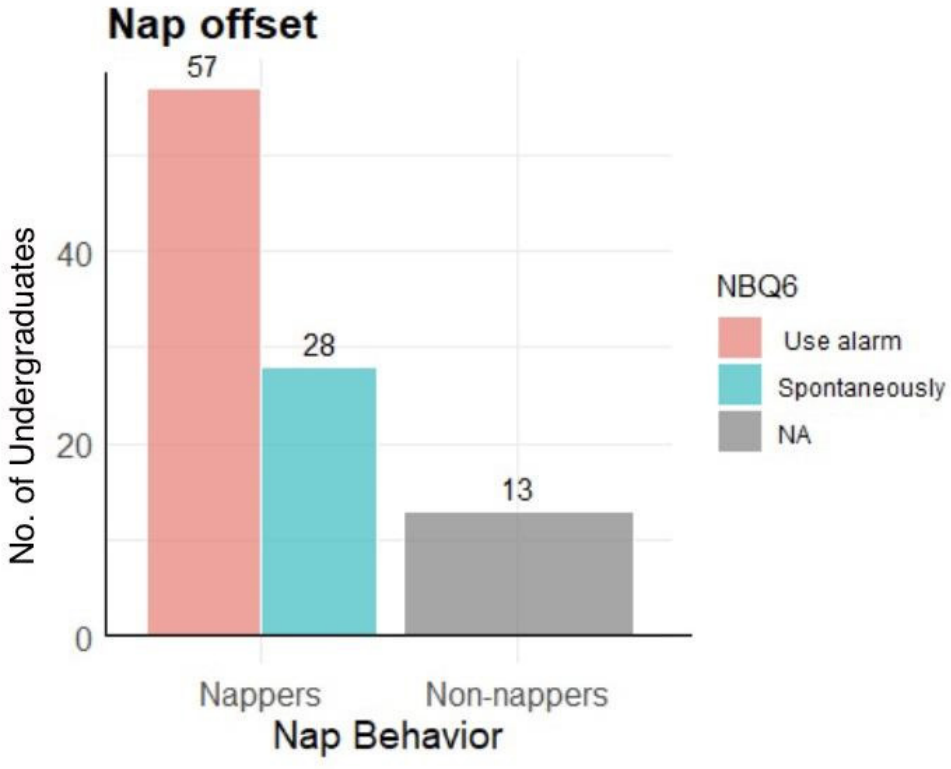

Figure 4c: Type of offset of the naps among medical students using NBQs.

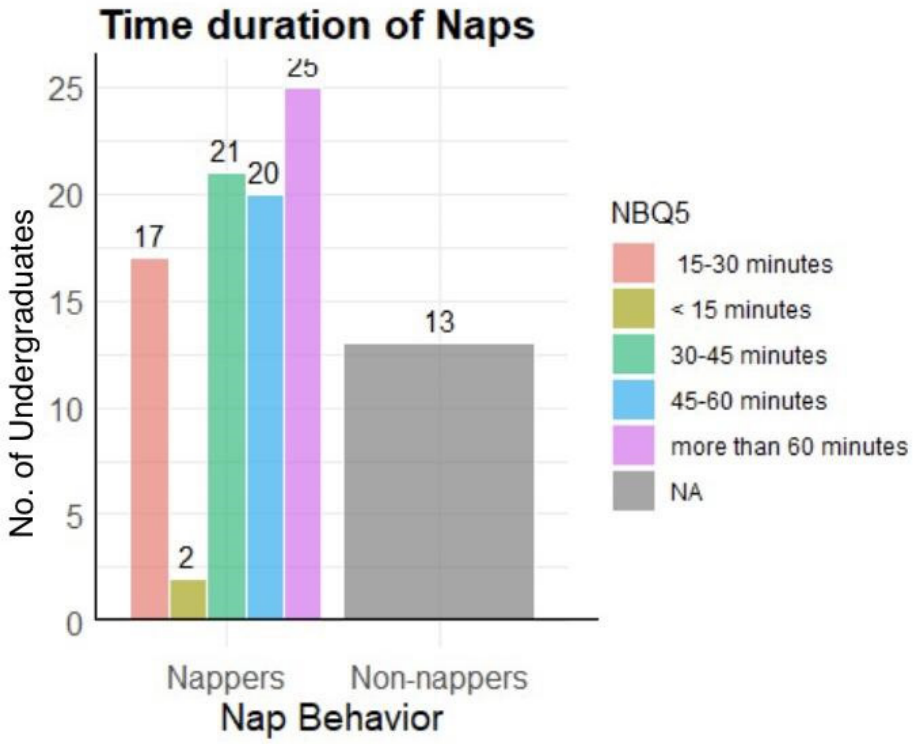

Figure 4d: Time duration of the naps among medical students using NBQs.

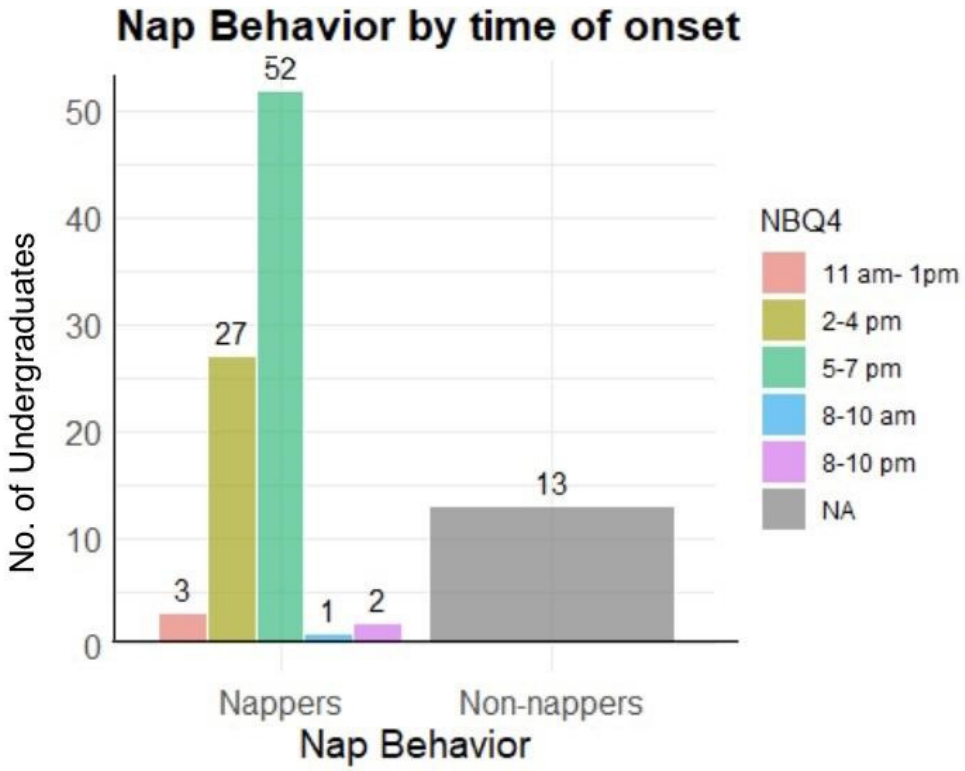

Figure 4e: Time of onset of the naps among medical students using NBQs.

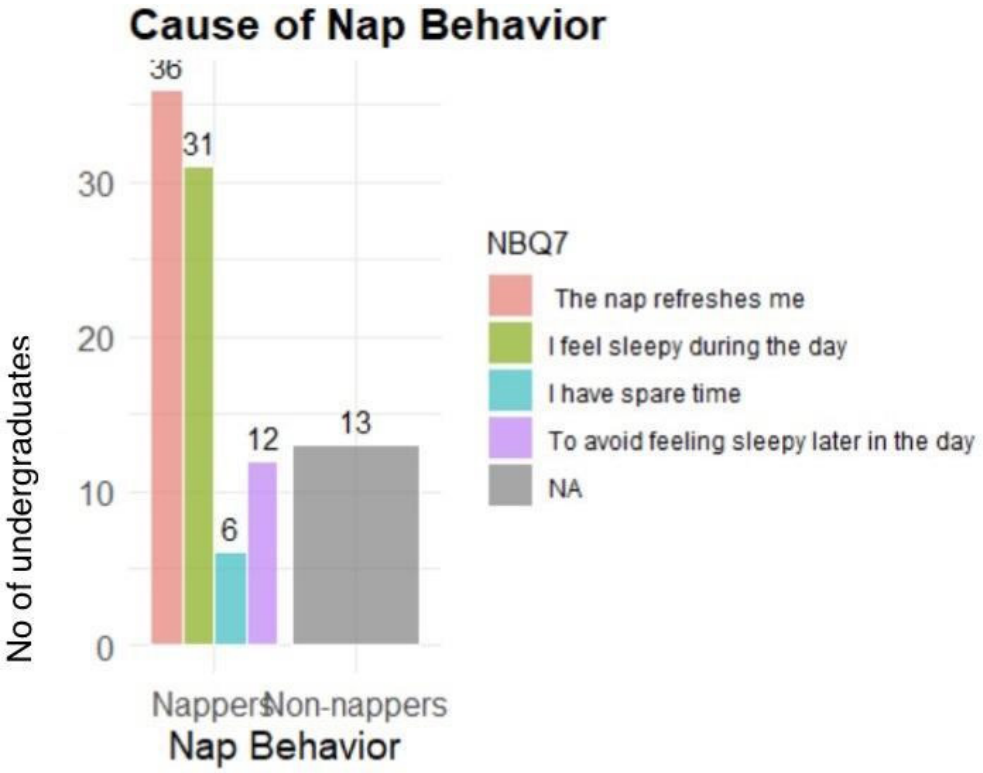

Figure 4f: Cause of nap behavior among medical students using NBQs.

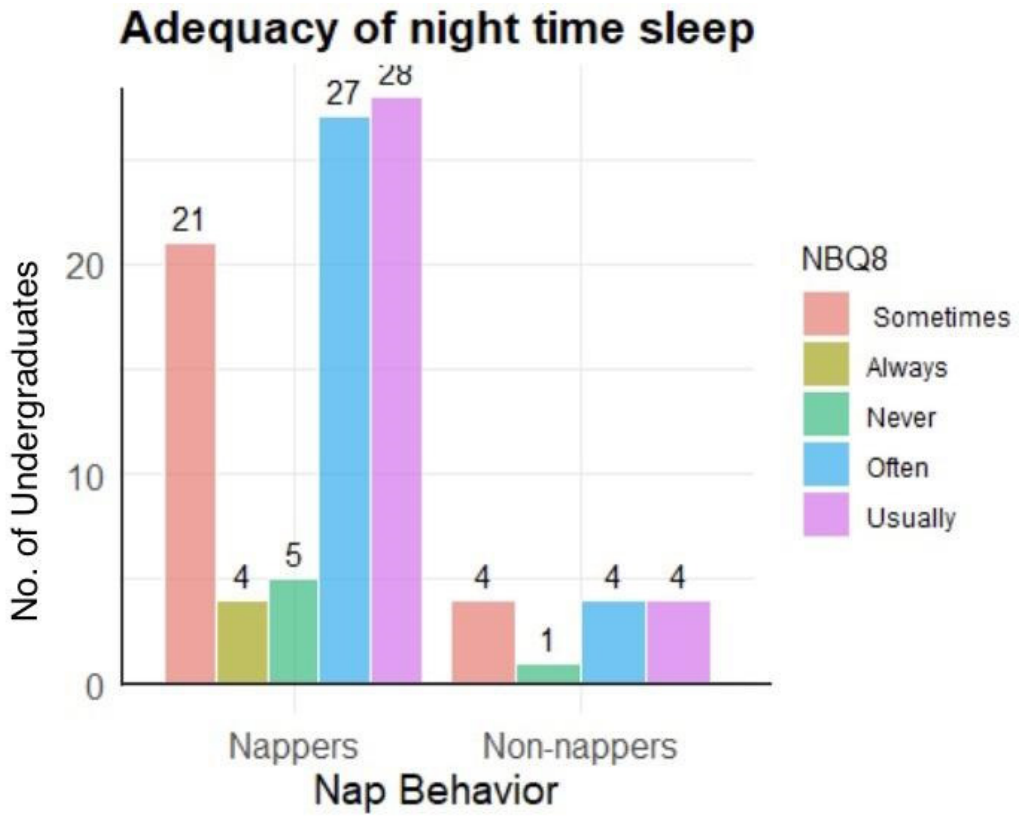

Figure 4g: Adequacy of nighttime sleep among medical students using NBQs.

finding is also confirmed by Figure 4f of NBQ analysis, which shows that most students felt refreshed after napping. The reason for not getting significant results for daytime napping reaction time may be sleep inertia, which hampers medical graduates from overcoming late-night sleep deprivation effects on cognitive performance.[11-13,21-27] The present study also observed a decrease in reaction time for the non-nappers, though it is not statistically significant. This may be because non-nappers' involvement in their extra-curricular activities positively affected their reaction time. These findings are supported by a previous study[26] which showed a significant improvement in cognitive performance among daytime nappers, who napped for 15 min and 45 min; also observed the significant cognitive performance in nappers *vs.* non-nappers.[5,21,22,26,27] However, due to the small sample size, the present study found no significant results among the nappers *vs.* non-nappers group for simple motor reaction time and sub-component analysis of sleep quality scores.

The present study also assessed the overall well-being scores, sleep quality, mental fatigue scores and daytime feeling and functionality among the nappers and non-nappers groups. Our study didn't find a significant difference in the WHO well-being scores, mental fatigue and daytime feeling and functioning between the nappers *vs.* non-nappers. This may be due to the small sample size for the non-nappers group for the real-time/true comparison. Previous studies have found a positive influence of daytime napping on subjective well-being, sleep quality, decreased sadness and anger and mental fatigue among nappers *vs.* non-nappers.[11,22-24] This may be due to the positive effects of napping that enhanced one's well-being by reducing their whole-day stress levels, further making them overcome negative emotions and contributing to improved overall mood and emotional well-being. However, a few contradictory findings were also observed and worse overall daytime functioning was observed, with greater feelings of depressed mood, reduced attention and positive emotions among nappers when compared to non-nappers.[5,8,9]

An interesting correlation was observed between napping duration and global sleep quality scores among the napper group and a significant positive association between nap duration and global sleep quality scores was observed. This association reflects that as the evening hours of napping duration increase, the total sleep quality decreases, further affecting the subject's well-being and inability to overcome the day-to-day stress conditions. This positive association is affirmed by the significant negative correlation between WHO well-being scores (which means better overall well-being) with the scores for DFFS, PSQI and MFS, representing better well-being after late afternoon napping with a significant improvement in mental fatigue, sleep quality and better daytime feelings and functioning following napping; hence, affirms that napping is beneficial for psycho-cognitive performances among nappers. Also, a shorter duration of napping is beneficial for better psycho-cognitive processing. These findings were supported by Mead M *et al.*,[18] study showed that longer nap duration was significantly associated with longer sleep onset latency. Few previous studies didn't observe any significant

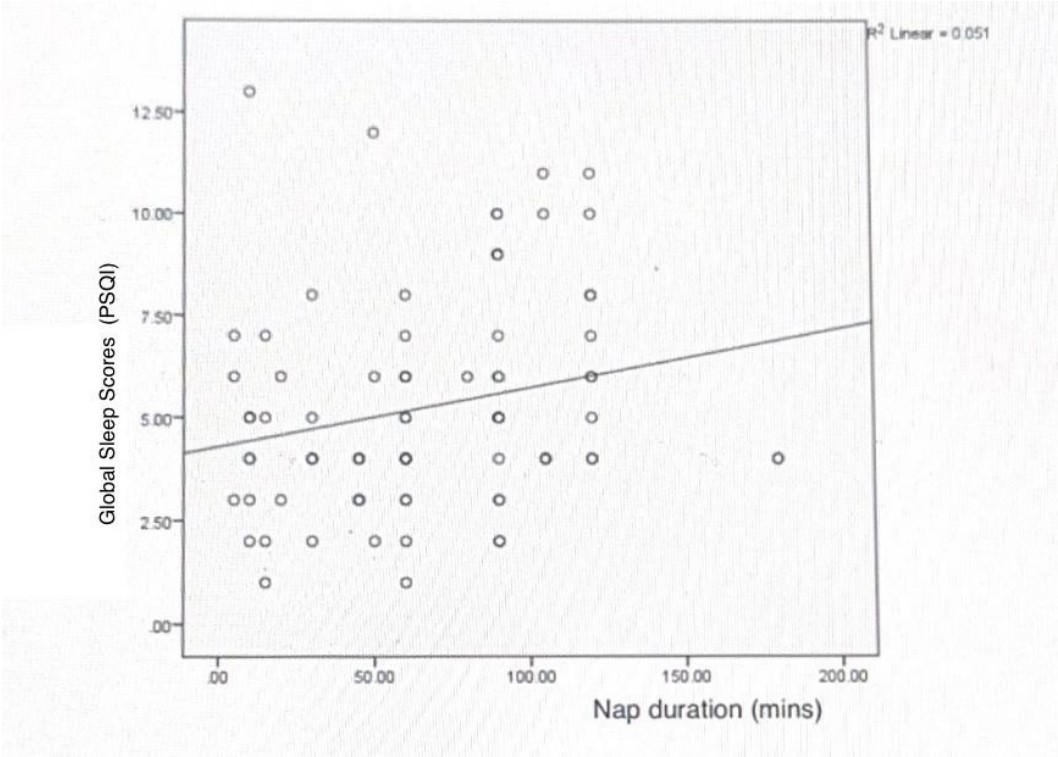

Figure 5: Correlation graph between Nap duration (min) and Global PSQI scores among napper's group.

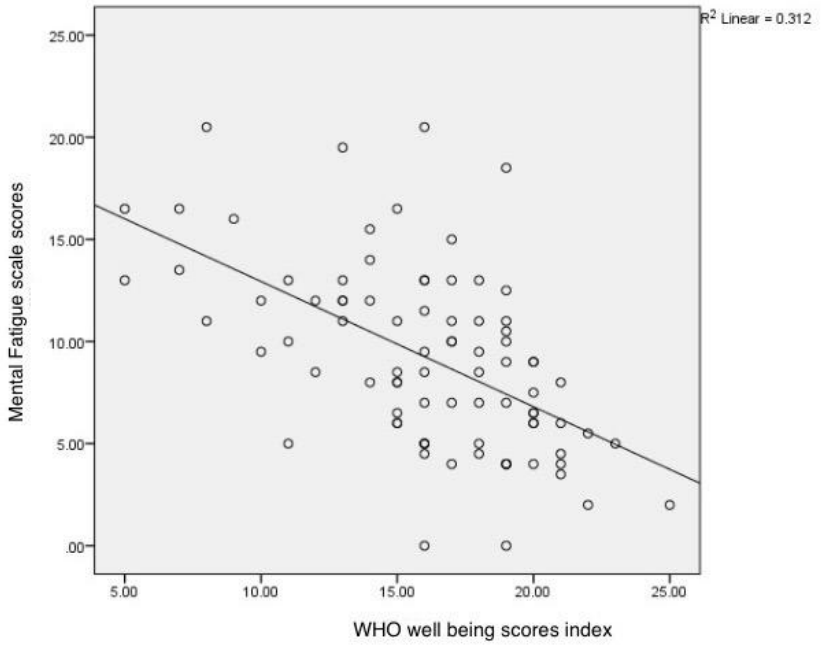

Figure 6: Correlation graph between WHO well-being scores and Mental Fatigue Scale scores among napper's group.

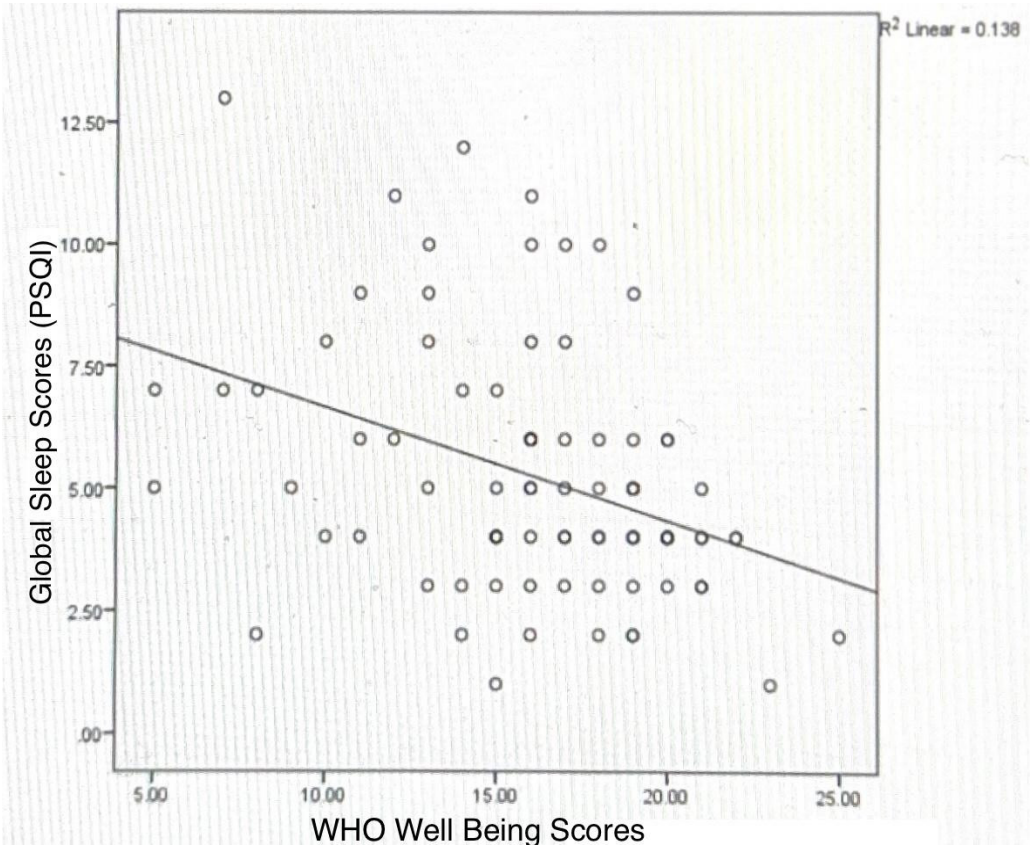

Figure 7: Correlation graphs between WHO well-being scores and Global PSQI scores among napper's group.

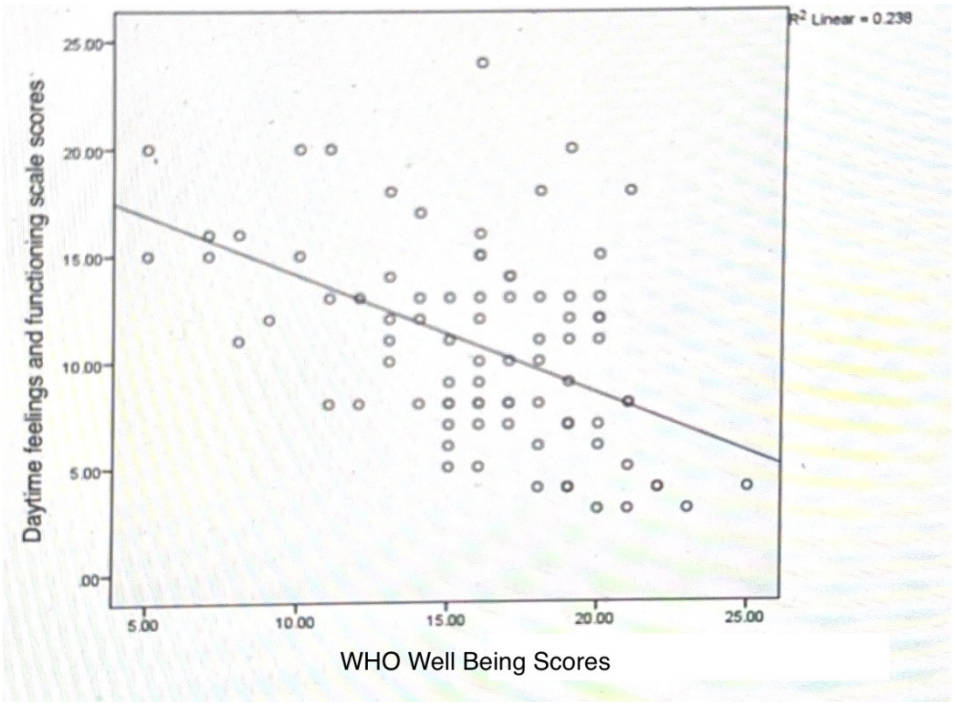

Figure 8: Correlation graphs between WHO well-being scores and DFFS scores among napper's group.

association between napping behavior and sleep quality among athletes' nappers *vs.* non-nappers group.[12]

The present study comprised medical undergraduate first-year students who were specifically selected for their cognitive assessment associated with napping behavior so that potential pharmacological and non-pharmacological interventions could be done to effectively prevent cognitive decline associated with napping behavior in their future as they age. Further, longitudinal studies are warranted to understand the association between different cognitive domains associated with napping behavior to rule out their beneficial effects on one's life.

The present study is the first study from India with scientific evidence that has evaluated the effect of napping behavior on psycho-cognitive tasks among Indian medical graduates and has also assessed that napping is beneficial for our life using simple motor reaction time. Although the study was conducted with a relatively sound methodology, it has a few limitations. Firstly, due to the small sample size, the findings of this study need to be corroborated in larger sample studies because the study being time-bound short-term research for undergraduate students (2 months) could not afford a larger sample. Secondly, gender-based analysis couldn't be conducted for the present study due to the small sample size. Thirdly, the present study couldn't rule out which duration (hours) of napping is beneficial, either daytime or evening hours, due to the small sample size. Fourth, the present study has not included any blood biomarkers associated with the cognitive domain analysis for objective assessment. Further, the diet assessment could not be carried out for undergraduate students to better correlate with napping behavior. Despite these limitations, the present findings provide psycho-cognitive evidence to show the benefits of napping on cognitive status among undergraduate students. The present study is still ongoing in the department with further conclusive findings.

CONCLUSION

The present study concluded that napping is a potential and powerful 'public health tool' and a countermeasure for sleep loss in reducing accidents and cardiovascular events and improving sleep-restriction-sensitive working performance. Findings have shown that shorter naps are beneficial for better sleep quality and further enhance cognitive processing. Also, simple motor reaction time and sleep quality index may be used as a screening tool for the early detection of cognitive impairment associated with napping behavior among medical undergraduates.

ACKNOWLEDGEMENT

The undergraduate student (MBBS) 2nd Year would like to thank all the participants and staff of the Department of Physiology who have contributed to this study to make it successful.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

DFFS: Daytime Feelings and Functioning Scale; **MFS:** Mental Fatigue Scale; **NBQ:** Napping Behaviour Questionnaire; **PSQI:** Pittsburgh Sleep Quality Index; **SRT:** Simple Reaction Time;

SMRT: Simple Motor Reaction Time; **WHO:** World Health Organization; **WHO-5:** World Health Organization-5 Well-Being Index.

REFERENCES

1. Dinges DF. Adult napping and its effects on ability to function. In: Stampi C, editor. Why we nap. Boston: Birkhäuser Verlag; 1992. p. 118-34. doi: 10.1007/978-1-4757-2210-9_9.
2. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. Sleep. 2010;33(5):585-92. doi: 10.1093/sleep/33.5.585, PMID 20469800.
3. Gallicchio L, Kalesan B. Sleep duration and mortality: a systematic review and meta-analysis. J Sleep Res. 2009;18(2):148-58. doi: 10.1111/j.1365-2869.2008.00732.x, PMID 19645960.
4. Faraut B, Léger D, Medkour T, Dubois A, Bayon V, Chennaoui M, *et al.* Napping reverses increased pain sensitivity due to sleep restriction. PLOS One. 2015;10(2):e0117425. doi: 10.1371/journal.pone.0117425, PMID 25723495.
5. Macchi MM, Boulos Z, Ranney T, Simmons L, Campbell SS. Effects of an afternoon nap on nighttime alertness and performance in long-haul drivers. Accid Anal Prev. 2002;34(6):825-34. doi: 10.1016/s0001-4575(01)00089-6, PMID 12371787.
6. Milner CE, Cote KA. Benefits of napping in healthy adults: impact of nap length, time of day, age and experience with napping. J Sleep Res. 2009;18(2):272-81. doi: 10.1111/j.1365-2869.2008.00718.x.
7. Baxter V, Kroll-Smith S. Normalizing the workplace nap: blurring the boundaries between public and private space and time. Curr Sociol. 2005;53(1):33-55. doi: 10.1177/0011392105048287.
8. Bursztyn M, Ginsberg G, Hammerman-Rozenberg RR, Stessman J. The siesta in the elderly: risk factor for mortality? Arch Intern Med. 1999;159(14):1582-6. doi: 10.1001/archinte.159.14.1582, PMID 10421281.
9. Lovato N, Lack L, Wright H. The napping behavior of Australian university students. PLOS One. 2014;9(11):e113666. doi: 10.1371/journal.pone.0113666, PMID 25412257.
10. Cao Z, Shen L, Wu J, *et al.* The effects of midday nap duration on the risk of hypertension in a middle-aged and older Chinese population: preliminary evidence from the Tongji-Dongfeng Cohort Study. Chin J Hypertens. 2014;32(10):1993-8; discussion 1998.
11. Mehta KJ. Effect of sleep and mood on academic performance-at the interface of physiology, psychology and education. Humanit Soc Sci Commun. 2022;9(1):16. doi: 10.1057/s41599-021-01031-1.
12. Stephenson KL, Trbovich AM, Vandermark LW, McDermott BP, Henry LC, Anderson MN, *et al.* Exploring the effect of napping on sleep quality and duration in collegiate athletes. J Am Coll Health. 2022;70(5):1451-6. doi: 10.1080/07448481.2020.1803881, PMID 32813619.
13. Mograss M, Abi-Jaoude J, Frimpong E, Chalati D, Moretto U, Tarelli L, *et al.* The effects of napping on night-time sleep in healthy young adults. J Sleep Res. 2022;31(5):e13578. doi: 10.1111/jsr.13578, PMID 35253300.
14. Pandey RM, Nair NS. nMaster 2.0 – Sample Size Software; 2011. Available from: cmc-biostatistics.ac.in.
15. Badau D, Baydil B, Badau A. Differences among three measures of reaction time based on hand laterality in individual sports. Sports (Basel). 2018;6(2):45. doi: 10.3390/sports6020045, PMID 29910349.
16. Gradisar M, Lack L, Harris J, *et al.* Psychometric properties of two new scales for measuring daytime functioning for insomnia. Sleep (Suppl). 2006;29(8):A339.
17. Johansson B, Rönnbäck L. Evaluation of the Mental Fatigue Scale and its relation to cognitive and emotional functioning after traumatic brain injury or stroke. Int J Phys Med Rehabil. 2014;2(1):1-7.
18. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4, PMID 2748771.
19. Nylén-Eriksen M, Bjørnnes AK, Hafstad H, Lie I, Grov EK, Lara-Cabrera ML. Validating the five-item World Health Organization well-being index. Int J Environ Res Public Health. 2022;19(18):11489. doi: 10.3390/ijerph191811489, PMID 36141760.
20. Mead MP, Huynh P, Le TQ, Irish LA. Temporal associations between daytime napping and nocturnal sleep: an exploration of random slopes. Ann Behav Med. 2022;56(11):1101-9. doi: 10.1093/abm/kaac006, PMID 35195690.
21. Romdhani M, Dergaa I, Moussa-Chamari I, Souissi N, Chaabouni Y, Mahdouani K, *et al.* The effect of post-lunch napping on mood, reaction time and antioxidant defense during repeated sprint exercise. Biol Sport. 2021;38(4):629-38. doi: 10.5114/biolspor t.2021.103569, PMID 34937973.
22. Ji X, Li J, Liu J. The relationship between midday napping and neurocognitive function in early adolescents. Behav Sleep Med. 2019;17(5):537-51. doi: 10.1080/15402002.2018.1425868, PMID 29388804.
23. Liu J, Feng R, Ji X, Cui N, Raine A, Mednick SC. Midday napping in children: associations between nap frequency and duration across cognitive, positive psychological well-being, behavioral and metabolic health outcomes. Sleep. 2019;42(9):zsz126. doi: 10.1093/sleep/zsz126, PMID 31135911.
24. Peth J, Regen F, Bajbouj M, Heuser I, Anghelescu I, Hornung OP. The influence of daytime napping versus controlled activity on the subjective well-being of patients with major depression. Psychiatry Res. 2012;200(2-3):368-73. doi: 10.1016/j.psychres.2012.06.020, PMID 22789840.
25. Oriyama S, Miyakoshi Y. The effects of nighttime napping on sleep, sleep inertia and performance during simulated 16-h night work: a pilot study. J Occup Health. 2018;60(2):172-81. doi: 10.1539/joh.17-0070-OA, PMID 29269604.
26. Cousins JN, Leong RL, Jamaluddin SA, Ng AS, Ong JL, Chee MW. Splitting sleep between the night and a daytime nap reduces homeostatic sleep pressure and enhances long-term memory. Sci Rep. 2021;11(1):5275. doi: 10.1038/s41598-021-84625-8, PMID 33674679.
27. Fan J, Wang L, Yang X, Zhang X, Song Z, Wu S, *et al.* Night shifts in interns: effects of daytime napping on autonomic activity and cognitive function. Front Public Health. 2022;10:922716. doi: 10.3389/fpubh.2022.922716, PMID 36299766.

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