

**Title: -**

**Effect of Internet Addiction on Sleep Quality and Cognitive Functions among medical students: A Cross-sectional study in North Indian Medical College.**

**Author contributions**

**Authors have accepted responsibility for the entire content of this manuscript and approved its submission.**

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**Contributions to manuscript - Concept and design of the study, data collection**

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**Informed and written consent was obtained from all individuals included in this study**

**Conflicts of interest**

**There are no conflicts of interest in this study**

**Ethical approval**

**Research involving human subjects complied with all relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration (as revised in 2013), and has been approved by the authors' institutional review board of Human Ethics Committee of Hind Institute of Medical Sciences, Safedabad, Barabanki.**

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## **Abstract**

### **Background & objectives**

The Internet is being used by all age groups for social networking and professional work. Excessive use of the internet has the potential to change sleep quality resulting in reduced cognitive functions. This study aimed to know the effect of Internet addiction (IA) on sleep quality, and cognitive functions among medical students.

### **Methods**

The study was done on 30 medical students of age group 18-35 years including males and females from first to final professional. The data of the Internet Addiction Test (IAT), Pittsburgh sleep quality index (PSQI), and Trail making test (TMT) were tabulated and expressed as mean  $\pm$  Standard deviation. The Correlation of different variables was done and presented in the form of correlation coefficients (r-value) to assess the strength of associations.  $p$ -value  $< 0.05$  was considered statistically significant for the association between the two variables.

### **Interpretation & conclusions**

The results show the average ( $\pm$ SD) sleep latency (the amount of time it takes to fall asleep, measured in minutes) was 39.58 minutes with an average score of  $1.37 \pm 0.97$ , while the average sleep duration score was  $1.03 \pm 0.70$  (actual sleep hours) among respondents. A positive correlation was seen between poor sleep quality and cognitive functions. TMT A and TMT B were on a normal time scale ( $P > 0.05$ ), depicting no effect of internet addiction and cognitive functions.

### **Conclusion-**

Sleep latency was an increased and deranged cognitive function in poor sleepers. However, we did not see any link between IA and cognitive functions. To control the IA and its impact on health and academics, some measures are to be implemented for awareness among medical students. Furthermore, studies are required to completely understand the factors that affect sleep behavior and cognitive functions in Internet addicts among medical students.

**keywords** – cognitive function, internet addiction (IA), medical students, sleep quality, sleep latency (SL)

### **Introduction**

Adequate healthy sleep is essential for normal physical development, memory consolidation, learning, critical thinking, and decision-making<sup>1</sup>. The Internet is used for education, entertainment, online shopping, and internet gaming due to its easy and fast access. It has been argued that excessive use of the internet could demonstrate addictive behavioral patterns<sup>2</sup>.

A study conducted on the neuropsychological profile among the internet-addicted population showed that mild users have fairly better control of mental speed and attention as well as cognitive functions<sup>3</sup>. A cross-sectional study investigated the correlation between sleep quality and IA among female college, moderate and severe degree of IA was found to be correlated with poor quality of sleep<sup>4</sup>. The potential relationship between IA and certain cognitive problems has been suggested by several studies<sup>4,5,6,7</sup>.

Medical students are overburdened due to their high load of academic activities, online studies, and lack of outdoor activities all can lead to sleep disturbance and impaired performance<sup>8</sup>. It became possible to use the internet excessively, especially during COVID - 19 pandemic resulting in internet addiction. A study conducted on Indian medical students (MBBS), observed that internet overuse is associated with poor sleep quality and high resting heart rate<sup>9</sup>. Sleep deprivation can result in serious outcomes including reduced coping mechanisms, poor academic performance<sup>10</sup>, excessive daytime, poor sleep quality, mood changes, and poor health outcomes such as obesity and low self-esteem<sup>11</sup>.

These pieces of literature demonstrate the relationship between sleep quality and the level of Internet addiction. To this day, there is a lack of extensive studies targeting sleep quality and the level of Internet addiction in medical students in this particular region. Advances in the broader areas of IA will facilitate the understanding of the cause, mechanism, and effect of this behavioral addiction. Analysis of risk factors, as well as their interactions, is crucial for understanding the development of IA. It is imminent to investigate the various cognitive as well as neurological aspects of IA as a model of addictive behavior. The present study aimed to evaluate the effect of internet addiction on sleep patterns and cognitive functions among undergraduate medical students in north Indian medical students.

## **Materials and Methods**

All the participants were selected from medical college undergraduate students (MBBS students -1, II, III, and IV professional years) of Hind Institute of medical sciences (HIMS) Safedabad Barabanki Uttar Pradesh, India, a tertiary care teaching hospital in a rural setting after taking a detailed history and medical examination. The data collection was started after getting permission from the institutional ethics committee (Ref no. IEC/IRB No: HIMS/IRB/2019-20/1635(a)). They were asked to complete a structural questionnaire based on Internet Addiction Test (IAT), Pittsburgh sleeps quality index (PSQI), and Trail making test (TMT). All the measurements were performed in an isolated examination room in presence of an attendant, under similar laboratory conditions. The study was performed under the Indian Council of Medical Research Short Term Studentship (ICMR STS – 2020) program (Ref no – 2020 - 05306) for 2 months duration. Apparently, healthy young students of the age group 18-35 years were recruited. As this study was time-bound restrictions for completion, we randomly selected 30 medical students. The details of the procedure were explained to the participants, and written informed consent was obtained. The anonymity and confidentiality of all the participants were maintained at all levels.

## **Inclusion Criteria**

Healthy internet-addicted young adults, male and female both.

## **Exclusion Criteria:**

1. Those participants who were on any medication, especially affecting the sleep pattern.
2. Those participants who were suffering from any metabolic disorder (Diabetes Mellitus, Hypertension, and Thyroid disorder), any cardiovascular or neuropsychiatric disorder.
3. Those participants who were having any cognitive disorders.
4. Diagnosed with psychiatric disorders.
5. Chronic smoker, tobacco chewer.
6. Night shift workers.

**Internet Addiction Test (IAT)<sup>12</sup>:** IAT is a reliable and valid measure of addictive use of the Internet. It consists of 20 items that measure the mild, moderate, and severe levels of Internet Addiction. Participants will answer all questions by using the scale: -

0 = Does not apply; 1 = Rarely; 2 = Occasionally; 3 = Frequently; 4 = Often, 5 = Always. All the scores were totaled- up using the scores for each item. Higher the score, greater the level of addiction. Score 20 – 49 points: average online user, can control his/her usage. Score 50 – 79 points: experiencing occasional or frequent problems because of the Internet. Score 80 – 100 points: Internet usage is causing significant problems in his/her life.

**Pittsburgh sleeps quality index (PSQI)<sup>13</sup>:** Subjective sleep quality of all participants was assessed with the help of the PSQI Questionnaire. The PSQI contains 19 self-rated questions and 5 questions rated by a bed partner or roommate (if one is available). Only self-rated questions were included in the scoring. The 19 self-rated items were combined to form seven "components" scores each of which has a range of 0 - 3 points. The seven components included are: Subjective sleep quality score, Sleep latency score, Sleep duration score, Habitual sleep efficiency score, Sleep disturbance score, Sleep medication score, Day time dysfunction score. In all cases, a score of "0" indicates no difficulty while a score of "3" indicates severe difficulty. The seven components' scores were added to yield one "global score" with the range of 0 - 21 points, "0" indicating no difficulty and "21" indicating severe difficulties in all areas.

**Trail-making test (TMT)<sup>14</sup>:** TMT is a short and convenient estimate of cognitive functions, principally attention and working memory. The TMT consists of two parts, A and B. Part A consists of one sample test and one task. The numbers are randomly printed on the sample worksheet. The participants joined the consecutive numbers in order by drawing connecting lines. The worksheet consists of numbers 1 to 25. The time taken to join consecutive numbers was taken as score A. Part B consists of a sample test as well as the main task. The numbers 1 to 4 and the letters A to D will be presented on a sample worksheet. The numbers 1 to 13 and letters A to L were presented on the task worksheet. The participants were asked to join alternate between numbers and letters in an ascending sequence. The investigator was pointing out errors as they did so that he/she can complete the test without errors. The score B will be again based on the time taken. If the time taken to complete Part A is less than the time taken to complete Part B, the subject is considered to have difficulties in complex conceptual tracking. In general, performance is considered to be impaired if scores exceed 40 seconds for part A and 91 seconds for part B.

**Plan of data analysis/ statistical tools:** The data of results from the Internet Addiction Test (IAT), Pittsburgh sleep quality index (PSQI), and Trail making test (TMT) were tabulated in the form with the help of a Microsoft excel workbook and expressed as mean  $\pm$  Standard deviation. The Correlation of different variables was done and presented in the form of correlation coefficients (r-value) to assess the strength of associations. p-value  $< 0.05$  was considered statistically significant for the association between the two variables.

### **Observations and results**

Our aim in this study was to examine the relationship between internet addiction and sleep quality and also cognitive functions among medical students. The mean age of the subject is  $(21.71 \pm 1.31)$ . PSQS varied between 0 and 21 with an average global score is  $6.14 \pm 2.84$  points. IA scores fell between 0 and 100 with an average of  $42.91 \pm 13.31$  (score 50 – 79 points: experiencing occasional or frequent problems because of the internet). The average sleep latency (the amount of time it takes to fall asleep, measured in minutes) was 39.58

minutes with an average score of  $1.37 \pm 0.97$ , while the average sleep duration score was  $1.03 \pm 0.70$  (actual sleep hours) among respondents (table I). A significant statistical correlation was found between sleep quality and IA (Figure 1). In this study, we did not find any correlation between IA and cognitive functions (Figure 2,3). It was also seen a positive correlation between poor sleep quality and cognitive functions (Figure 4,5). TMT A  $26.29 \pm 6.51$  and TMT B  $53.07 \pm 13.43$  (table I) which were in normal time scale.

<b>Table I: Different study Parameters of participants: Mean and SD</b>	
<b>Parameters</b>	<b>Mean <math>\pm</math> SD</b>
Age	21.71 $\pm$ 1.31
Gender	NA
IAT	42.91 $\pm$ 13.31
SSQ	1.11 $\pm$ 0.63
SL	1.37 $\pm$ 0.973
SD	1.03 $\pm$ 0.70
HSE	0.31 $\pm$ 0.47
Step D	1.17 $\pm$ 0.56
S med	0.09 $\pm$ 0.50
DTD	1.03 $\pm$ 0.61
Global PSQI	6.14 $\pm$ 2.06
TMT A	26.29 $\pm$ 6.51
TMT B	53.07 $\pm$ 13.43

#### Abbreviation: -

Not applicable (NA), Subjective sleep quality (SSQ), Sleep latency (SL), Sleep duration (SD), Habitual sleep efficiency (HSE), Sleep disturbance score, Sleep medication (D med), Day time dysfunction (DDT), Internet Addiction Test (IAT), Pittsburgh sleep quality index (PSQI) and Trail making test (TMT)

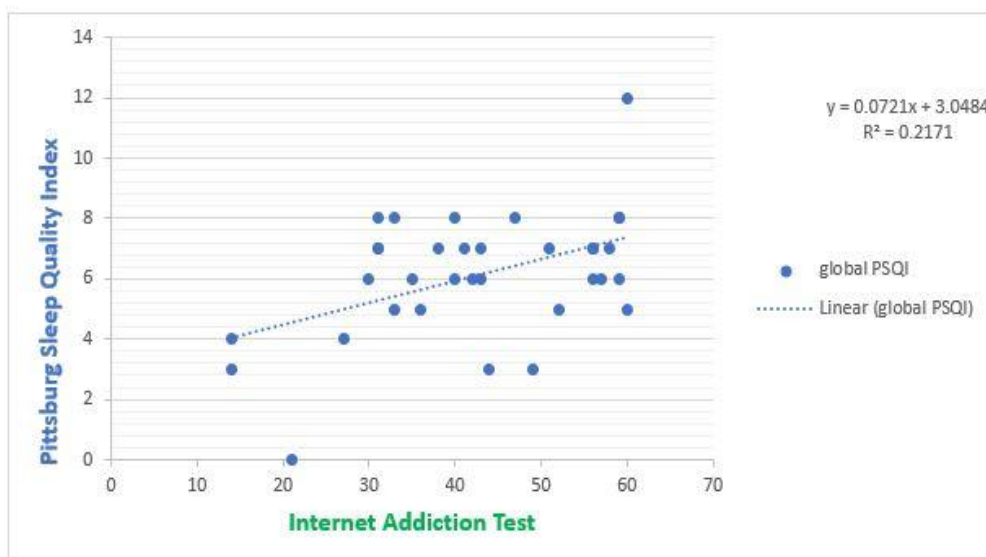


Figure 1: Sleep quality in Internet addiction individuals

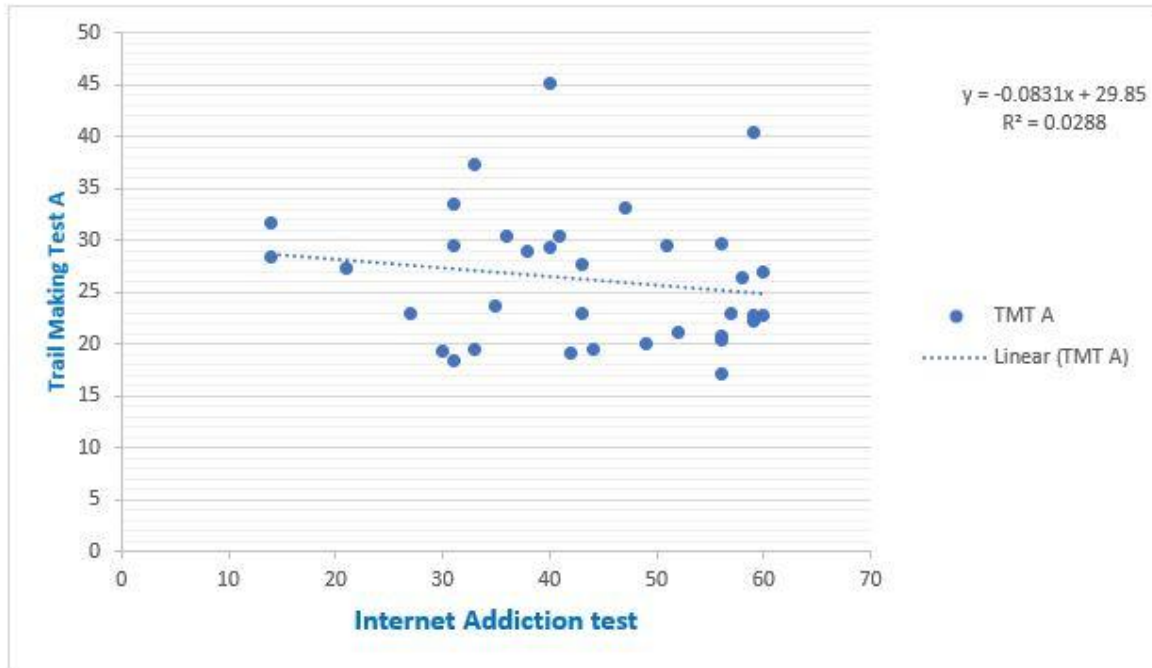


Figure 2 shows correlation between Internet addiction and cognitive function

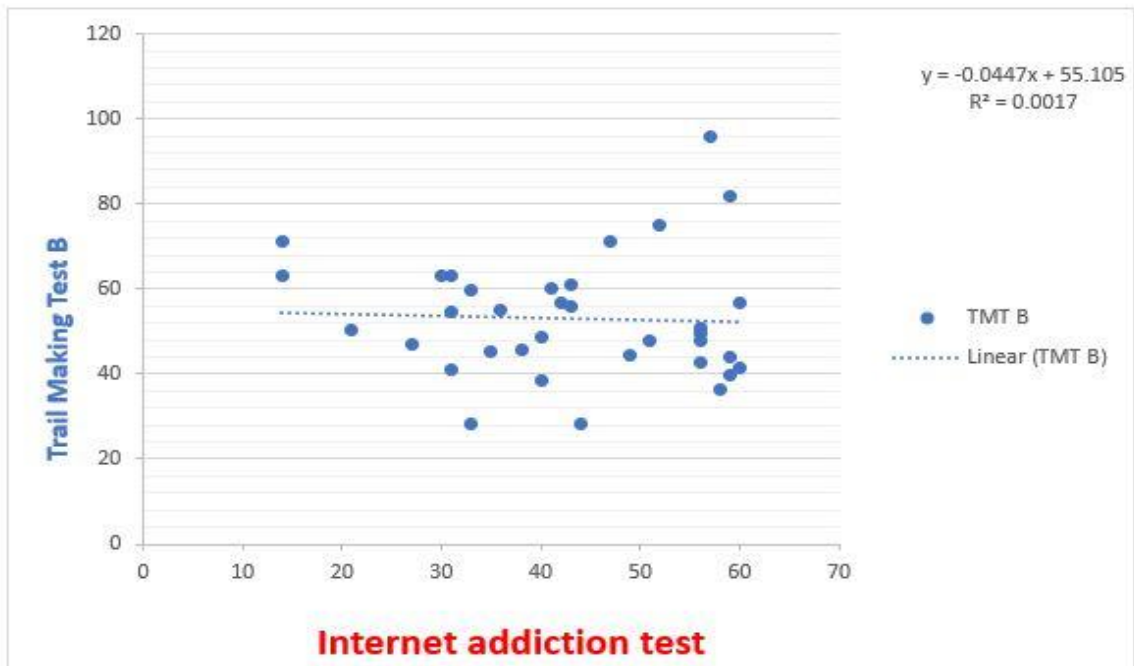
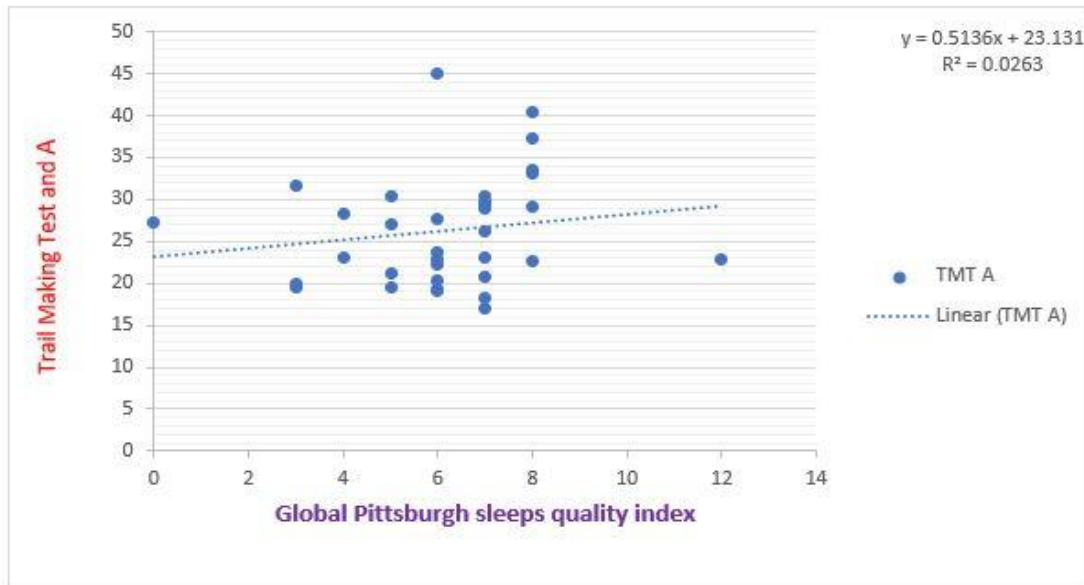
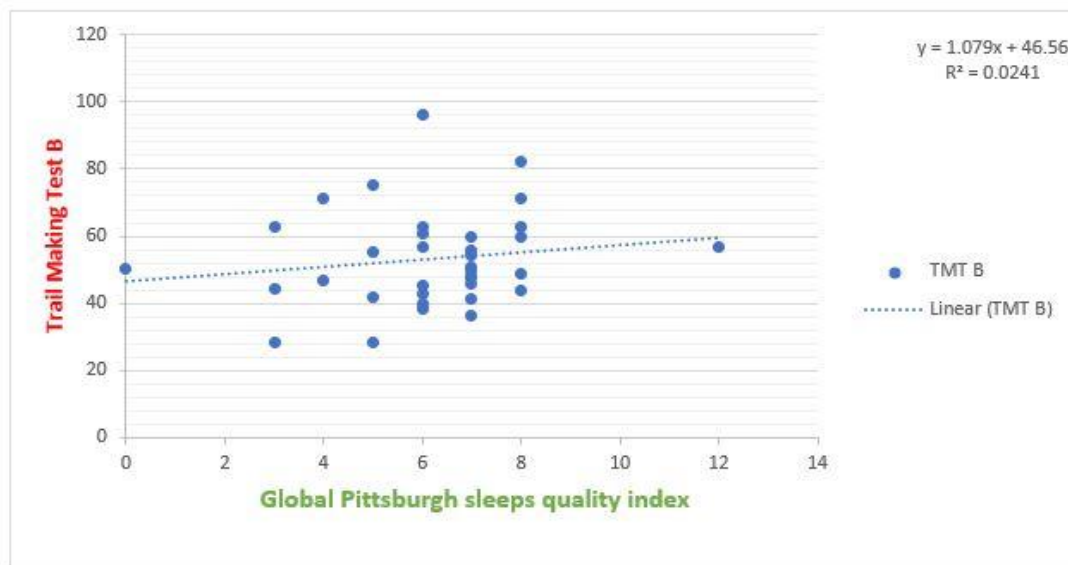


Figure 3: Correlation between Internet addiction and cognitive function



**Figure 4: Correlation between sleep patterns and cognitive function among Internet addiction**



**Figure 5: Correlation between sleep patterns and cognitive function in Internet addiction**

## Discussion

Our study shows that overindulgence on the internet affects overall sleep quality. This study is similar to others<sup>1,9,14</sup> in which sleep disturbance was seen as related to internet addiction. Research done on medical students in Western Maharashtra medical college found a significant association of IA with poorer sleep quality and a higher feeling of stress<sup>15</sup>. Research showed that Internet addiction contributes to the disturbed circadian rhythm that may negatively influence bedtime and sleep duration, leading to daytime fatigue and impaired work performance<sup>16</sup>.



The cognitive functions like working memory and abstract reasoning were not affected in our study which was in contrast to other studies<sup>9,10</sup> which could be due to many reasons like subjects were not severely internet addicted, the sample size was small or the study is having a more female subject.

We also found that cognitive functions were slowed down in poor sleepers. Quality of sleep affects the academic performance and interpersonal relationships of students and predisposes them to various mental illnesses. Studies have shown that poor sleepers are associated with poor academic performance in medical students<sup>17</sup>. Firth et al<sup>18</sup> draws on psychological, psychiatric, and neuroimaging findings to examine several key hypotheses on how the internet is possibly altering our cognition. They explore how distinctive features of the online world may be affecting (a) attention capacities (b) memory processes and (c) social cognition.

The prevention measures and early detection of consequences and related corrective measures can change the quality of life and health-related burden on society. There is a growing need for programs to raise awareness of IA as well as its impact on sleep among medical students. Furthermore, strategies are required to limit the use of the Internet and promote healthy sleep habits to improve sleep quality, also encourage extracurricular activities. Further study requires with larger sample size to fully explore the factors that affect sleep behavior and IA among undergraduate medical students.

### **Limitations-**

The present study has certain limitations. The sample size was small and limited to 30 individuals due to time constrain, narrow range of age group, and limited to only medical students residing in hostels, which prevents generalization of results. In addition, more female participants were included in this study. Further study with a larger sample size from different groups of the population is needed to allow for broader generalization of the results. Effect of day and night time internet addict on these parameters. As it is a cross-sectional study, it does not give any cause-effect relationship.

### **Conclusion**

In summary, the present questionnaire-based cross-sectional study was done on the "Effect of internet addiction on sleep pattern and cognitive functions in medical undergraduates" at Hind institute of medical sciences Safedabad Barabanki, done on 30 MBBS students in two months duration after ethical clearance. This research has provided some important information about internet addiction among medical students and their patterns of sleep. The results indicate that there is a significant relationship between internet addiction and health, and quality of sleep which can lead to untoward consequences in students. It was found that students have poor control over their internet use which may indirectly affect their work performance, difficulty in establishing concentration, low academic output, increased dependency, and behavioural changes which overall affect their performance in academic as well as daily life.

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### Conflicts of interest

There are no conflicts of interest in this study

### Source of support

The study is approved and supported by Indian Council of Medical Research (ICMR)

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