Original Article

DOI: 10.7860/JCDR/2026/85365.23227

Physiology Section

Effect of Ramadan Fasting on Visual and Auditory Reaction Time in Malaysian Medical Students Studying in India: A Prospective Observational Study

VARSHA M SHINDHE[1], SUHASINI KANYADI[2], FAREEDABANU BALIKAI[3], MAHESHKUMAR M SHINDHE[4], JYOTI M BENNI[5], SUDHA AMBIGER[6], AMIT MAGADUM[7]

ABSTRACT

Introduction: Ramadan fasting, a significant religious practice, is associated with physiological and circadian alterations that may affect neurocognitive function, particularly reaction time, an objective marker of sensory-motor processing speed and alertness. Reaction time is especially relevant in medical students, who require sustained mental alertness and efficiency. Despite its importance, there is limited and inconsistent evidence on how Ramadan fasting affects reaction time in healthy Southeast Asian medical students.

Aim: To assess the impact of Ramadan fasting on visual and auditory reaction times among healthy Malaysian medical students studying in India.

Materials and Methods: This prospective observational study was conducted in the Department of Physiology at USM-KLE International Medical Programme, Jawaharlal Nehru Medical College (JNMC) Campus, Belagavi, Karnataka, India, from February 2025 to March 2025. A total of 104 apparently healthy Malaysian medical students aged 18-25 years who were observing Ramadan fasting were included. Visual (green and red light) and auditory (tone and click) reaction times were measured using a standardised reaction time apparatus one week before Ramadan and during the fourth week of fasting to assess cumulative physiological and circadian effects of sustained fasting on reaction time. Data were analysed using the Wilcoxon signed-rank test and Mann-Whitney U test via Statistical Packages of Social Sciences (SPSS) version 23.0, with $p<0.05$ considered statistically significant.

Results: The study included 40 males and 64 females with mean age 21.47±1.66 years. In male participants, both visual and auditory reaction times were significantly prolonged during the fasting period compared to the prefasting phase ($p<0.001$ for all parameters). Similarly, female participants also demonstrated a statistically highly significant increase in both visual and auditory reaction times during fasting compared to prefasting values ($p<0.001$ for all parameters). However, no significant gender differences in visual or auditory reaction times were observed during the fasting period.

Conclusion: Ramadan fasting is associated with a significant delay in visual and auditory reaction times in both genders, indicating transient cognitive slowing in healthy young adults. These findings highlight the neurocognitive implications of Ramadan fasting, particularly in tasks requiring rapid visual and auditory responses.

Keywords: Attention, Circadian rhythms, Cognition, Psychomotor performance

INTRODUCTION

Many civilisations and religions observe the practice of fasting. During the month of Ramadan, Muslims who are physically capable refrain from eating and drinking for 12 to 14 hours every day. They also rise early for prayers, eat early before sunrise, retire later, and eat substantial meals after dusk [1]. This intermittent fasting during Ramadan can lead to physiological and chronobiological changes, including alterations in sleep patterns, hydration, and nutritional intake [2]. According to the research, cognitive functions can be influenced by dehydration, meal intake, and sleep deprivation and variations in these parameters are seen during Ramadan fasting [3]. Additionally, shifting the timing of meals may cause changes in sleep patterns, which may have an impact on alertness during the day and, in turn, cognitive functions [2-4]. Although there is no malnutrition or insufficient calorie intake during Ramadan, which sets it apart from other fasting periods, most individuals report less activity, less motivation to study, and poorer focus during the Ramadan fast [5]. Furthermore, many individuals who fast during Ramadan correlate their fasting with increased daytime sleepiness and lower performance [6].

Cognitive function includes several key components such as reaction time, attention and memory. Reaction time is a vital aspect of cognitive function, allowing individuals to quickly respond to changing situations and environments, making it essential for effective decision-making and action [7]. Response time is the amount of time that elapses between receiving an abrupt signal and reacting to it. The stimuli may be visual, auditory or tactual [8]. Although reaction time has various physiological components, such as the emergence of a stimulus at the receptor level, its transmission to the central nervous system, the production of effector signals, and stimulation of the muscles to produce mechanical work, the majority of reaction time happens during the stages of neural transmission of the stimulus and the production of the effector signal [9]. Several factors can influence reaction time, including age, gender, education level, environmental factors like altitude, lifestyle factors such as habits, alcohol, and nicotine, as well as the type of stimulus and alertness [10,11].

As Ramadan fasting is obligatory for Muslims, understanding its impact on cognitive function is essential, particularly for individuals who engage in daily activities that require quick reactions and decision-making. Despite a growing interest in understanding the cognitive effects of Ramadan fasting, existing literature presents conflicting results [12]. Several studies have reported prolonged reaction times and reduced alertness during fasting, suggesting

transient cognitive slowing, particularly during the later weeks of Ramadan [13-15], These effects have been attributed to dehydration, altered sleep duration, circadian rhythm disruption, and cumulative fatigue [2,6,16]. Conversely, other studies have demonstrated minimal or no adverse effects of Ramadan fasting on reaction time, proposing adaptive physiological and behavioural mechanisms that preserve cognitive performance in healthy individuals [17-19]. These inconsistencies highlight important gaps in the literature and hence the need for more focused investigations, especially in young, healthy populations. Studying its effects on Malaysian medical students can provide valuable insights for individuals, educators, and policymakers. Medical students, due to their academic and clinical responsibilities, represent a group where optimal cognitive functioning is essential. The novelty of present study lies in employing a prospective observational design to evaluate within-subject changes between prefasting and fasting phases, while simultaneously assessing both visual and auditory reaction times in a Southeast Asian medical student population, for which limited data seem to be available.

The present study aimed to assess the effect of Ramadan fasting on visual and auditory reaction times among healthy Malaysian medical students studying in India.

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Physiology, USM-KLE International Medical Programme, JNMC Campus, Belagavi, Karnataka, India, from February to March 2025. The study was approved by the Institutional Ethics Committee of KLE Centenary Charitable Hospital and MRC, Belagavi (Ref No: EC/KLECCH/09-2024). Written informed consent was obtained from all participants prior to study enrolment. The research was conducted following the Declaration of Helsinki guidelines.

Sample size calculation: The sample size was calculated by the statistician, and the calculated sample size was n=45 using 95% confidence level and Zβ=0.84 for 80% power.

Thus, the minimum required sample size for paired comparison was approximately 46 participants. To enable gender-based subgroup analysis and to maintain adequate statistical power within each subgroup, the sample size was doubled. Additionally, an allowance was made for potential dropouts. Therefore, a total of 104 medical students (40 males and 64 females) were recruited using a convenient sampling method.

Inclusion criteria: Participants were included if they voluntarily provided written informed consent, were aged between 18 and 25 years, and were physically and mentally fit to perform cognitive testing procedures.

Exclusion criteria: Individuals were excluded if they had a history of diabetes, hypertension, or neurological disorders; reported substance abuse such as alcohol, tobacco, or recreational drugs; had known hearing or visual impairments; or were diagnosed with sleep disorders, anxiety, or musculoskeletal disorders of the upper limb.

Study Procedure

All participants were apparently healthy Malaysian medical students. Participants were residing at the host Institution in Belagavi and observing traditional Ramadan fasting from 2nd March to 30th March 2025, abstaining daily from food and fluids from sunrise (approximately 5:19 am) to sunset (approximately 6:51 pm, local time). Reaction time measurements were recorded in two sessions: prefasting (one week before Ramadan, i.e., in February 2025) and fasting (during the fourth week of Ramadan in March 2025). For all participants, both sessions were conducted at the same time of day (between 10:00 am and 1:00 pm) to minimise the influence of diurnal variations. Participants were fully informed about the purpose, methods, and equipment of the study prior to the experiment. Participant information, including age and sex, was obtained using structured proformas and personal interviews.

A validated reaction time apparatus (Anand Agency, Pune) was used to record each participant's audiovisual reaction time. It gauges reaction time in both optical (green and red) and aural (tone and click) domains. Digital displays are used to show the readings. The built-in digital chronoscope on the examiner's side calculates the reaction time in milliseconds. Before taking the readings, the subjects were given a proper trial and an explanation of the technique. Every test was conducted at ambient temperature in a quiet environment. Pre-informing the subjects on the stimulus they would get throughout the trial helped to reduce their stress. They were instructed to stay ready by keeping their respective operative hands close to the response button and to respond when they saw the lightbulb illuminate (for visual reaction time) and when they heard sounds of different intensities (for auditory reaction time). The study employed the following stimuli to measure reaction times: For auditory stimuli: beep tone and a click, and for visual stimuli, red and green lights. Following few trial and error, each participant eventually provided a total of 12 readings, which included six visual reaction time readings (three for green light and three for red light) and six auditory reaction time readings (three for tone and three for click). The mean of these readings were used for analysis.

STATISTICAL ANALYSIS

Data were analysed using SPSS Version 23.0. Values expressed as mean±SD. Wilcoxon signed-rank test and Mann-Whitney U test were used for comparisons. A p-value <0.05 was considered statistically significant.

RESULTS

The study participants included 104 Malaysian medical students with a mean age of 21.47±1.66 years, as shown in [Table/Fig-1]. In male participants visual reaction time for both green and red light was significantly prolonged during the fasting period compared to the prefasting phase, and this increase was statistically highly significant (p<0.001). Similarly, auditory reaction time for both tone and click stimuli was significantly increased during fasting compared to prefasting values, with statistically highly significant differences (p<0.001) [Table/Fig-2].

Variables	Value
Age (in years), (Mean±SD)	21.47±1.66
Gender n (%)	
Males	40 (38.5)
Females	64 (61.5)

[Table/Fig-1]: Demographic characteristics of the study participants (n=104).

Reaction time parameters (s)	Visual reaction time (s)		Auditory reaction time (s)	
	Green Mean±SD	Red Mean±SD	Tone Mean±SD	Click Mean±SD
Prefasting	0.12±0.04	0.11±0.05	0.11±0.04	0.12±0.05
Fasting	0.21±0.06	0.19±0.06	0.19±0.06	0.18±0.05
Test statistic	t=9.983	t=8.523	Z=6.343	t=6.677
p-value	<0.001*	<0.001*	<0.001*	<0.001*

[Table/Fig-2]: Auditory reaction time between prefasting and fasting in males (n=40). SD: Standard deviation; t: Paired t-test; Z: Wilcoxon signed-rank test; *p<0.05 considered statistically significant

In female participants visual reaction time for both green and red light was also significantly prolonged during the fasting period compared to the prefasting phase with statistically highly significant differences (p<0.001). Likewise, auditory reaction time for tone and click stimuli also showed significant prolongation during fasting compared to

prefasting values, which was statistically highly significant (p<0.001) as shown in [Table/Fig-3]. Prefasting visual and auditory reaction times were compared between male and female participants. No significant gender differences were observed for green, red, or tone reaction times (p>0.05). However, auditory 'click' reaction time was marginally longer in males compared to females, with the difference reaching statistical significance (p=0.049) [Table/Fig-4].

Reaction time Parameters (s)	Visual reaction time (s)		Auditory reaction time (s)	
	Green Mean±SD	Red Mean±SD	Tone Mean±SD	Click Mean±SD
Prefasting	0.10±0.04	0.11±0.04	0.12±0.05	0.11±0.05
Fasting	0.21±0.09	0.21±0.10	0.18±0.08	0.18±0.06
Z-value	*Z*=4.974	*Z*=4.731	*Z*=3.999	*Z*=4.745
p-value	<0.001*	<0.001*	<0.001*	<0.001*

[Table/Fig-3]: Auditory reaction time between prefasting and fasting in females (n=64). Z: Wilcoxon signed-rank test, *p<0.05 considered statistically significant, Reaction time values are expressed in seconds (s).

Reaction time parameters (s)	Males (Mean±SD)	Females (Mean±SD)	Z-value (Mann-Whitney U)	p-value
Green	0.12±0.04	0.10±0.039	1.777	0.075
Red	0.11±0.05	0.11±0.036	0.180	0.857
Tone	0.11±0.04	0.12±0.05	0.434	0.664
Click	0.12±0.05	0.11±0.05	1.971	0.049*

[Table/Fig-4]: Comparison of prefasting visual and auditory reaction times between males and females.
Mann-Whitney U test, *p<0.05 considered statistically significant, Reaction time values are expressed in seconds (s).

Visual and auditory reaction times recorded during the fasting phase were compared between male and female participants. No statistically significant gender differences were observed for any of the reaction time parameters (green, red, tone, or click; all p>0.05) [Table/Fig-5].

Reaction time parameters (s)	Males (Mean±SD)	Females (Mean±SD)	Z-value (Mann-Whitney U)	p-value
Green	0.21±0.06	0.21±0.09	0.985	0.325
Red	0.19±0.06	0.21±0.10	0.579	0.579
Tone	0.19±0.06	0.18±0.08	1.650	0.099
Click	0.18±0.05	0.18±0.06	0.704	0.481

[Table/Fig-5]: Comparison of fasting visual and auditory reaction times between males and females.
Mann-Whitney U test, Reaction time values are expressed in seconds (s).

DISCUSSION

The present study investigated the impact of Ramadan fasting on cognitive function in Malaysian youths, with a focus on reaction time to assess the speed of information processing and decision-making. This study observed that fasting significantly increased reaction times in both males and females showed significant increases in visual and auditory reaction times during fasting compared to prefasting states. This indicates fasting affects cognitive or physiological processing speed for these stimuli. Prefasting gender comparisons showed that males and females generally had similar reaction times for most auditory and visual stimuli although a difference was observed for the "Click" stimulus, where males and females differed in prefasting states. Fasting gender comparisons observed no significant gender differences in reaction times for any stimuli. Implications of this study suggest that Fasting has a notable impact on slowing reaction times in both genders. The consistent effect of fasting on reaction times across conditions and genders suggests that fasting may have a universal impact on cognitive and motor functions, regardless of gender [8,12]. These findings have practical implications for individuals who fast for religious, health or other reasons, particularly in contexts requiring sustained attention and rapid responses, where optimal performance is essential [15,16,20].

Research on Ramadan fasting's impact on cognitive function has garnered interest recently, with studies showing mixed outcomes [12-13,15,19]. The effects of Ramadan fasting on cognition vary across specific populations: Adolescents with potential impacts on learning and daily functioning as well as Athletes having possible influences on performance and decision-making [14,17]. These varying results highlight the need for context-specific understanding of Ramadan fasting's cognitive impacts. The systematic review by Pourabbasi A et al., studied the variability in findings across studies examining the impact of Islamic fasting on cognitive functions in adolescents and highlighted the need for more research in this area [12].

The findings of the present study are consistent with those of the studies that have found significant changes in cognitive performance during Ramadan fasting. A study done by Dolu N et al., found that Ramadan fasting significantly impacted cognitive functions, as measured by P300 event-related potential and the cancellation test, which aligns with present findings. It also suggested that the impact of Ramadan fasting on cognitive function may depend on various factors, such as age, physical fitness, and individual differences in response to fasting [13].

The physiological and chronobiological changes that occur during Ramadan fasting, such as alterations in sleep patterns, hydration, and nutritional intake, may influence cognitive function [4,6]. For example, a study done by BaHammam AS et al., found that Ramadan fasting affected sleep quality and duration [6]. Cognitive function is subject to the influence of circadian rhythms, showing fluctuating performance over the day. A study by Tian HH et al., on cognitive function during Ramadan in Muslim athletes observed that during Ramadan, performance in the areas of psychomotor functions or processing speed as well as visual attention or vigilance was found to be better at 0900h, but by late afternoon, a significant decrease was observed in psychomotor function/processing speed, verbal learning and memory performance. They attributed this to the combined effects of food intake, fluid and sleep restriction, stating that the effects of fasting on cognition, particularly those requiring sustained rapid responses, can vary depending on the domain and time of day [20].

According to a study by Bougrine H et al., the cognitive and psychomotor performance was significantly impacted by intermittent fasting during Ramadan, even though there were no comparable changes in their dietary consumption or body composition. This implies that cumulative fatigue and poor sleep quality, especially during the last week of fasting, are the main causes of the negative effects seen [14]. A study done on young boys by Miladi A et al., also reported the effects of Ramadan fasting on cognitive functions. These studies suggest that Ramadan fasting may have a negative impact on cognitive function in certain populations, such as adolescents or individuals who are not accustomed to fasting [3]. According to a study by Mertens A et al., Ramadan fasting had an effect on neuroperformance in healthy workers. The effects were mainly observed in: visual information processing and hand-eye coordination [15]. Another study by Dolu N et al., investigated the impact of Ramadan intermittent fasting on arousal and continuous attention. The study found that while Ramadan fasting did not significantly affect arousal levels, it did lead to increased reaction time to auditory stimuli, suggesting a potential decline in processing speed and a decrease in continuous attention, as measured by a cancellation test, indicating difficulties in sustaining focus [16].

However, results of the present study differ from other studies who have reported contrasting findings. Some studies have reported no significant effects of Ramadan fasting on cognitive function, including attention, memory, and reaction time [1,5,8,15]. Male and

female visual and auditory reaction times during and after fasting did not differ statistically, according to a study by Senol D et al., on the effect of Ramadan fasting on neuro performance in healthy individuals. This suggests that Ramadan fasting has no detrimental effects on neuro performance in healthy individuals [8]. According to a study done by Zarrouk N et al., Ramadan fasting did not impair neuromuscular performance or reaction times in trained karate athletes, suggesting that athletes can maintain their physical abilities during this period [17]. Similarly, a study done by Chamari K et al., found no significant impact of Ramadan intermittent fasting on cognitive function in trained cyclists [18]. Another study by Mertens A et al., also reported no significant influence of Ramadan fasting on neuroperformance in healthy workers [15]. A study by Yasin WM et al., clearly suggested that Fasting has been shown to have no effects on cognitive function [19]. These studies suggest that Ramadan fasting may not have a significant impact on cognitive function in individuals who are accustomed to fasting or have a high level of physical fitness.

While the findings of the current study are consistent with some previous research, further studies are needed to fully understand the impact of Ramadan fasting on cognitive function in different populations. The implications are noteworthy for fasting individuals in cognitively demanding roles, such as healthcare and academia. Longer reaction times may compromise attention and responsiveness, warranting strategies to mitigate performance decline during fasting. Future studies with multicentric designs, larger and more diverse populations, and incorporating additional physiological and lifestyle variables, including anthropometric measures, sleep patterns, hydration status, and fasting-related characteristics, may provide a more comprehensive understanding of inter-individual variability in neurocognitive responses during Ramadan fasting.

Limitation(s)

The present study evaluated within-subject changes in visual and auditory reaction times before and during Ramadan fasting in a cohort of healthy young medical students. The findings may not be generalisable beyond young, healthy adults, as older individuals and those with comorbidities were not included. Potential confounding factors such as sleep duration, hydration status, and psychological stress were not objectively assessed, which may have influenced reaction time measurements. In addition, correlations between reaction time changes and individual factors such as fasting tolerance or fasting duration could not be examined, as these parameters were not assessed.

CONCLUSION(S)

The study found that Ramadan fasting significantly increases visual and auditory reaction times in healthy Malaysian medical students. It suggests a temporary slowing of cognitive processing speed during fasting, observed consistently in both male and female participants. As reaction time is an objective measure of neurocognitive performance, it highlights significant changes during fasting in young adults. This research adds to the limited data from Southeast Asian medical students and calls for future studies in diverse populations to better understand fasting-related cognitive effects.

Acknowledgement

The authors thank all participants, the Head of Department of Physiology and the laboratory staff of USM KLE International Medical Programme, for their support.

Authors' contribution: VMS: Conceptualisation of the study, data collection, and manuscript drafting.SK and FB: Conceptualisation of the study, data collection, participant coordination, and literature review. MMS: Contributed to study design, statistical analysis, interpretation of results and critical manuscript revision. JMB: Supervised the study, validated methodology, guided data interpretation, and finalised the manuscript as the corresponding author. SA and AM: Provided expert input on study methodology, and critical review of the manuscript for intellectual content.

REFERENCES

[1] Roky R, Chapotot F, Benchekroun MT, Benaji B, Hakkou F, Buguet A. Daytime sleepiness during Ramadan intermittent fasting: Polysomnographic and quantitative waking EEG study. *Journal of Sleep Research.* 2003;*12*(2):95-101. https://doi.org/10.1046/j.1365-2869.2003.00339.x.

[2] Roky R, Houti I, Moussamih S, Qotbi S, Aadil N. Physiological and chronobiological changes during Ramadan intermittent fasting. *Ann Nutr Metab.* 2004;48(4):296-303. Doi: 10.1159/000081076.

[3] Miladi A, Saafi MA, Latiri I. Effects of Ramadan on cognitive functions in young boys. *Libyan J Med.* 2024;19:2301830. Doi: 10.1080/19932820.2024.2301830.

[4] Roky R, Iraki L, HajKhlifa R, Lakhdar Ghazal N, Hakkou F. Daytime alertness, mood, psychomotor performance, and oral temperature during Ramadan intermittent fasting. *Ann Nutr Metab.* 2000;44(3):101-07. Doi: 10.1159/000012830.

[5] Amin A, Kumar Sai S, Mishra S, Reddy UK, Sriram N, Mukkadan JK. Effects of fasting during Ramadan month on depression, anxiety, stress, and cognition. *Int J Med Res Rev.* 2016;4(5):771-74. Doi: 10.17511/ijmrr.2016.i05.18.

[6] BaHammam AS. Does Ramadan fasting affect sleep? *International Journal of Clinical Practice.* 2006;*60*(12):1631-37.

[7] Prabu Kumar A, Omprakash A, Kuppusamy M, Maruthy KN, Sathiyasekaran BWC, Vijayaraghavan PV, et al. How does cognitive function measured by reaction time and critical flicker fusion frequency correlate with academic performance of students? *BMC Med Educ.* 2020;20(1):507. Doi: 10.1186/s12909-020-02416-7.

[8] Senol D, Kisaoglu A, Canbolat M, Calisgan E, Duz S, Acak M, et al. Are visual and auditory reaction times influenced by Ramadan fasting? A neuroperformance study on healthy individuals. *Ann Med Res.* 2019;26(9):1751-54. Doi: 10.5455/annalsmedres.2019.08.480.

[9] Bompa T. *Theory and Methodology of Training.* 2nd ed. Dubuque (IA): Kendall Hunt Publishing Co.; 1990.

[10] Ricci B. *Experiments in the Physiology of Human Performance.* Philadelphia: Lea & Febiger; 1970.

[11] Maidikov L, Makarenko N, Kol'chenko N. Human higher nervous activity during adaptation to moderate altitude. *Zh Vyssh Nerv Deiat.* 1986;36:12-19.

[12] Pourabbasi A, Ebrahimnegad Shirvani MS, Shams AH. Does Islamic fasting affect cognitive functions in adolescents? A systematic review. *J Pak Med Assoc.* 2019;69(8):1164-69.

[13] Dolu N, Yapislar H, Khan A. Effect of Ramadan fasting on cognitive functions using P300 event-related potential and the cancellation test. *J Neurosci Clin Res.* 2018;3:01-03.

[14] Bougrine H, Chalghaf N, Azaiez C, Hammad AS, Boussayala G, Dhahri M, et al. Impact of intermittent fasting during Ramadan on psychomotor and cognitive skills in adolescent athletes. *Front Sports Act Living.* 2024;6:1362066. Doi: 10.3389/fspor.2024.1362066.

[15] Mertens A, Schouteden M, Godderis L. Influence of Ramadan on neuroperformance in healthy workers. *Med Res Arch.* 2015;3(1):01-11.

[16] Dolu N, Yiiksek A, Sizer A, Alay M. Arousal and continuous attention during Ramadan intermittent fasting. *J Basic Clin Physiol Pharmacol.* 2007;18(4):315-22. Doi: 10.1515/jbcpp.2007.18.4.315.

[17] Zarrouk N, Hammouda O, Latiri I, Adala H, Bouhlel E, Rebai H, et al. Ramadan fasting does not adversely affect neuromuscular performance and reaction times in trained karate athletes. *J Int Soc Sports Nutr.* 2016;13:18. Doi: 10.1186/s12970-016-0130-0.

[18] Chamari K, Briki W, Farooq A, Patrick T, Belfekih T, Herrera CP. Impact of Ramadan intermittent fasting on cognitive function in trained cyclists: A pilot study. *Biol Sport.* 2016;33(1):49-56. Doi: 10.5604/20831862.1185889.

[19] Yasin WM, Khattak MMAK, Mamat NM, Abu Bakar WAM. Does religious fasting affect cognitive performance? *Nutr Food Sci.* 2013;43(5):483-89. Doi: 10.1108/NFS-07-2012-0062.

[20] Tian HH, Aziz AR, Png W, Wahid MF, Yeo D, Png ALC. Effects of fasting during Ramadan month on cognitive function in Muslim athletes. *Asian J Sports Med.* 2011;2(3):145-53.

PARTICULARS OF CONTRIBUTORS:
1, Associate Professor, Department of Physiology, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Deemed to be University, Belagavi, Karnataka, India.
2. Associate Professor, Department of Community Medicine, University Sains Malaysia-KLE International Medical Programme, Belagavi, Karnataka, India.
3. Professor, Department of Physiology, University Sains Malaysia-KLE International Medical Programme, Belagavi, Karnataka, India.
4. Assistant Professor, Department of Community Medicine, Belagavi Institute of Medical Sciences (BIMS), Belagavi, Karnataka, India.
5. Associate Professor, Department of Pharmacology, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Deemed to be University, Belagavi, Karnataka, India.
6. Associate Professor, Department of Biochemistry, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Deemed to be University, Belagavi, Karnataka, India.
7. Associate Professor, Department of Anatomy, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Deemed to be University, Belagavi, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Jyoti M Benni,
Associate Professor, Department of Pharmacology Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research (KAHER), Deemed to be University, Belagavi-590010, Karnataka, India.
E-mail: bennijyoti@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Nov 26, 2025
- Manual Googling: Mar 07, 2026
- iThenticate Software: Mar 10, 2026 (5%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Nov 15, 2025**
Date of Peer Review: **Dec 13, 2025**
Date of Acceptance: **Mar 12, 2026**
Date of Publishing: **May 01, 2026**