Original Article

Vigilance Performance on the Digit Vigilance Test: Norms and Demographic Correlates from Eastern India

Rajarshi Chakravarty[1], Manami Bhadra[2], Sibasis Roy[1], Ankita Kar[1]
[1] Associate Professor, Department of Psychiatry, Jhargram Govt Medical College
[2] Research scholar, Department of Education Gujarat University, India

OPEN ACCESS

Corresponding Author:

Dr. Rajarshi Chakravarty
Associate Professor Psychiatry,
Jhargram Govt Medical College

A B S T R A C T

Background: Digit Vigilance Test (DVT) is widely used to assess sustained attention, processing speed and vigilance, which are core components of executive functioning. Indian normative data remain limited, and sociocultural factors are known to influence cognitive test performance.

Objective: To assess performance on the DVT among healthy Indian adults and determine the impact of demographic variables.

Methods: A cross-sectional study involving 132 healthy adults aged 18—60 years was conducted. Sociodemographic profile, vigilance time and vigilance errors were recorded. Inferential statistics included Chi-square tests, independent t-tests and one-way ANOVA with Tukey post-hoc analysis

Results: Age, education level and socioeconomic status significantly influenced vigilance time ($p < 0.05$). Undergraduate participants demonstrated significantly longer test duration than postgraduate-level participants. Vigilance time was significantly lower among upper-middle socioeconomic class participants. Students completed the task faster than teachers ($p < 0.05$).Humanities group were faster than the science students in the study. No significant association was found between vigilance errors and demographic variables.

Conclusion: Age, education and socioeconomic status are major determinants of vigilance performance in Indian adults, whereas gender, residence, stream of study, and religion do not significantly influence outcomes. These findings support the need for population-specific normative data to avoid diagnostic misinterpretation.

***Keywords**: sustained attention, vigilance, neuropsychological assessment, Digit Vigilance Test, normative data.*

INTRODUCTION

Sustained attention, also referred to as vigilance, is the ability to maintain cognitive focus over prolonged and unbroken periods.[1] It plays an essential role in daily functioning, including academic performance, driving, occupational efficiency, and safety—related decision- making. [2]Neurobiologically, vigilance involves multiple neurotransmitter pathways, particularly noradrenergic, serotonergic, cholinergic and histaminergic systems, which maintain arousal and cognitive steadiness during wakefulness[3,4] . Dopaminergic reward pathways, stress-response modulation and motivation also influence performance on vigilance tasks[4].

Neuropsychological assessment of vigilance is commonly accomplished using variants of the Continuous Performance Test (CPT). The Digit Vigilance Test (DVT)[5] is a simple analogue to CPT test, part of the NIMHANS Neuropsychological Battery- 2004[6], is a simple tool for assessing vigilance widely used in clinical practice in India. It asks the attempter to strike out all the "6"and "9"from a set of 1800 randomly selected numbers arranged in 60 rows as fast as they can. Thus it evaluates sustained attention ,processing speed and error monitoring without relying on linguistic or cultural familiarity. Poor DVT performance has been documented in patients with ADHD[7] , traumatic brain injury [8][9], dementia , and major psychiatric disorders like schizophrenia[10].

Demographic variables such as age, education, sex and socioeconomic status have been shown to influence vigilance[11][12][13][14][15], with majority studies showing slowing of responses and false hit rates with age[13],Gender related

findings remain inconsistent across populations[16][17] and contradictory. Considering India's linguistic, cultural and educational diversity and the paucity of Indian data in this regard ,establishing population-specific normative reference values is essential to avoid misclassification of impairment.

This study aimed to evaluate normal performance patterns on the Digit Vigilance Test (DVT) among healthy adults in Eastern India and examine the influence of socio-demographic variables on DVT.

Materials and Methods

Study Design: Cross-sectional study

Place of Study: Department of Psychiatry, Burdwan Medical College.

Study Duration: 1 month (1st December, 2023 – 30th June, 2024)

Study Population: normal adult male and females , fulfilling the selection criteria, who voluntarily participated in this study

Sample Size: 132

Sampling Method: Consecutive Purposive Sampling

Inclusion Criteria:
1. Any normal adult (> 18 yrs and < 60 yrs) male and female who voluntarily participated in this study
   Exclusion Criteria:
1. Person with a CGI-S[17] Score of '> 1 or 0 ' are excluded from the study
2. Person who have serious physical illness are excluded from this study
3. Person who are <18 yrs or > 60 yrs of age are also excluded from this study
   Study Variables:
1. Socio-Demographic variables like religion, age, sex, education, background etc
2. Digit Vigilance Time as per 'NIMHANS NEUROPSYCHOLOGICAL BATTERY- 2004'
3. Vigilance Mistake
   Technique: Interview method and assessment as per neuropsychology tools
   Data collection: pre-designed, semi-structured proforma for data collection
   Tools:
1. Proforma for data collection
2. CGI-S[18]
3. Digit Vigilance Test
4. Consent form
Statistical Analysis: Statistical methods using standard statistical software
Ethical clearance: Received clearance from The Institutional Ethics Committee of Burdwan Medical College

Results:

Our research is a cross-sectional study where participants, most of which are students (both medical and non-medical), teachers and doctors, voluntarily took part in this study. All kinds of psychiatric disorders were excluded by experienced psychiatrists. Moreover CGI-S was applied to confirm the exclusion of the same.
The results are as follows:

A. A.Socio-Demographic Profile:

In this study, among a total of 132 participants,74 male (56.1 %) and 58 (43.9%) female. Most of them (114)were Hindu by religion (86.4%).Rest were Muslims. There were 24 doctors (UG residents/UG/PG Residents) enrolled into the study Most of the patients were married 92 (69.7 %), 36 unmarried (29.7 %) and only 4(3%) were separated or divorced. Mean age 34 years.

96 participants (72.7%) were urban and 36 (27.3 %) were rural. 100 participants (75.8%) were socio-economically from upper class and 28 (21.2 %) from upper-middle and 4 (3%)were from lower-middle class. No representation from lower class. 98 (74.2%) students were from science stream and rest were from humanities. This study was done on students and teachers. So, 62 participants (47%) were students and rest were teachers.

All were educated people. Among participants 66 (53%) recently completed their post-graduation and 40 were Post Graduate trainees (30.3%). Only 2 participants were educated up to high school standard.

Table 1. Descriptive statistics for the total sample (N = 132).

Variable	Subgroup	Number (n)	Percentage (%)
1)Sex	Male	74	56.1%
	Female	58	43.9%
2)Marital status	Single	36	29.7%
	Married	92	69.7%

	Divorced/Separated	4	3%
3)Background	Urban	96	72.7%
	Rural	36	27.3%
4)Socio-economic class	Upper	100	75.8%
	Upper-middle	28	21.2%
	Lower-middle	4	3%
	Lower	0	0%
5)Stream	Science	98	74.2%
	Humanities	34	25.8%
6(Profession	Student	62	47%
	Teacher	70	53%
7)Education	PG Teacher	14	10.6%
	UG Teacher	8	6.1%
	Post Graduate	66	50%
	PG Student	40	30.3%
	UG Student	2	1.5%
	High School	2	1.5%
	Illiterate	0	0%
8)Religion	Hindu	114	87%
	Muslim	18	13%

B. Non-Parametric Test :
Chi-Square test done to examine if any association between categorical variable.
Significant association found among following variables :

1.background and education : χ^2(dF=5, N= 132) =21.01, p< 0.05 with phi co-efficient 0.40 indicating medium to strong relationship with urban people being educationally advanced
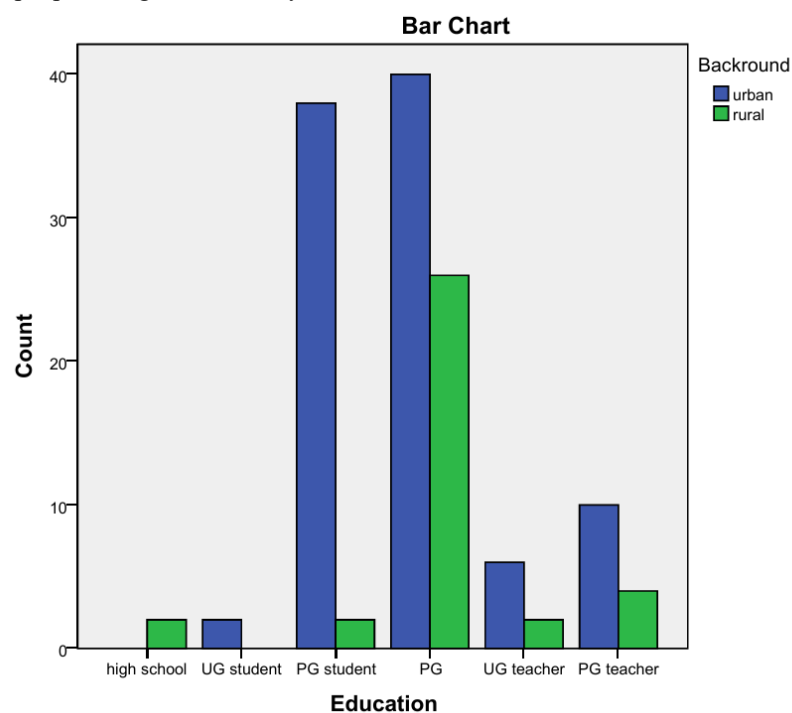

Bar Chart Showing Education Status and Background

2. Religion and education : χ^2 (dF=5, N= 132) =14.84, p< 0.05 with phi co-efficient 0.34 indicating small to medium relationship with Hindus being educationally advanced.
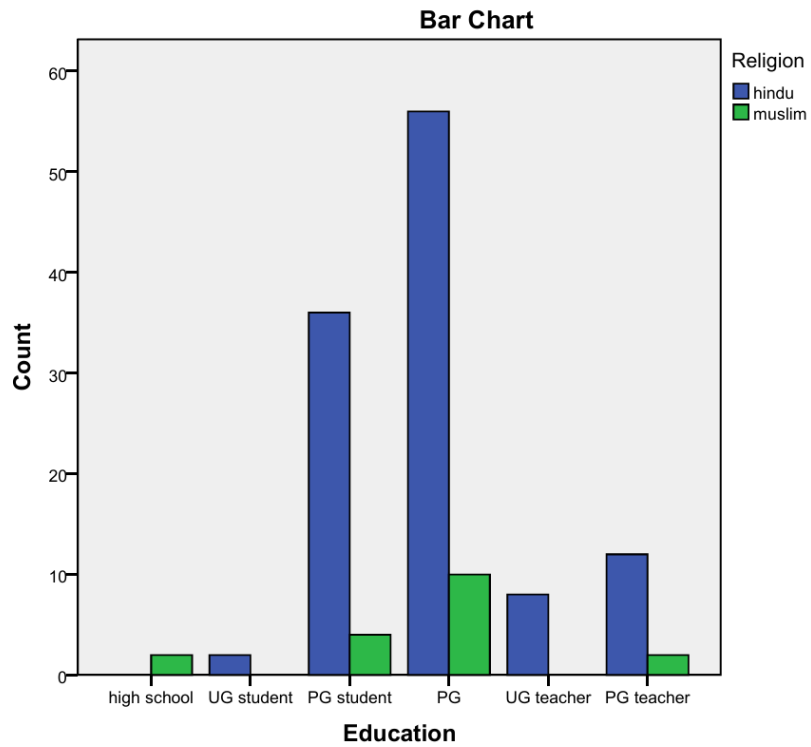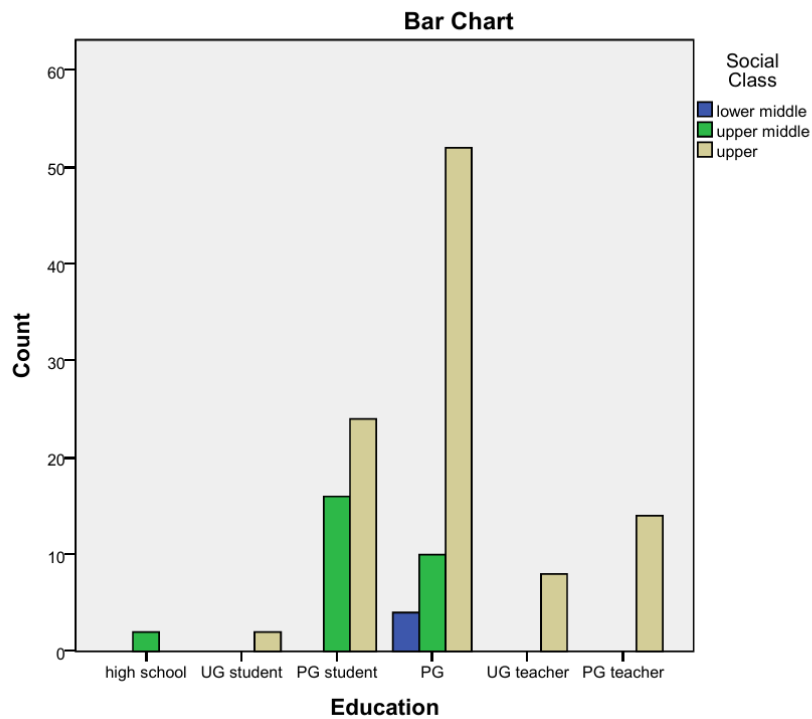
Bar Chart Showing Education Status and Religion

3.Sex and education : χ^2 (dF= 5, N= 132) =12.33, p< 0.05 with phi co-efficient 0.31 indicating small to medium relationship
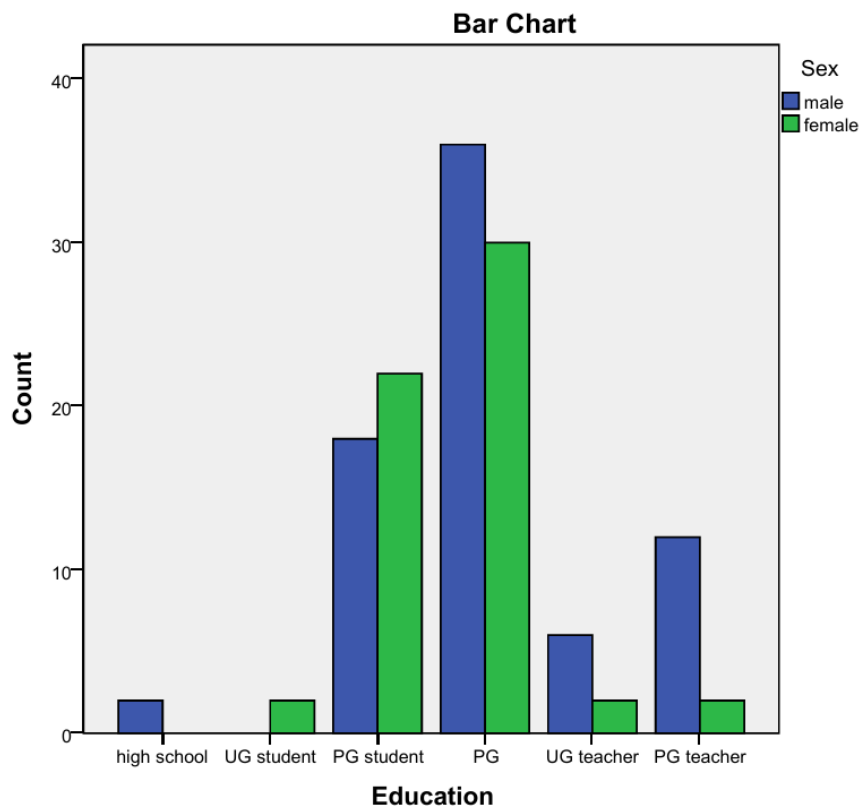
4.Social class and education : χ^2 (dF= 5, N= 132) =27.51, p< 0.05 with phi co-efficient 0.46 indicating medium to strong relationship

Bar Chart

5.Sex and stream : χ^2 (dF= 1, N= 132) =27.43, p< 0.001 with phi co-efficient 0.46 indicating medium to strong relationship

Bar Chart
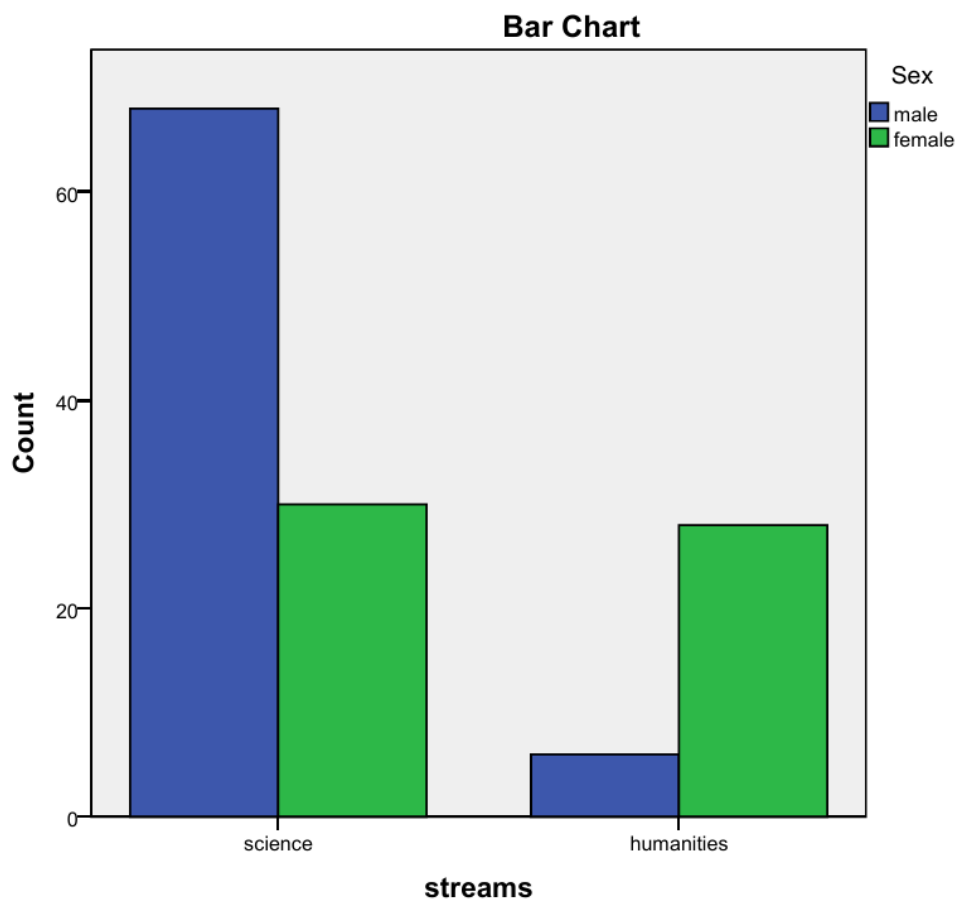
6.Social class and stream : χ^2 (dF= 2, N= 132) =55.06, p< 0.001 with phi co-efficient 0.65 indicating medium to strong relationship.

C.   Parametric Tests

To examine whether there is statistically significant difference in vigilance time with difference in social class or education status or marital status one-way between group ANOVA was done.

A one-way ANOVA was done to see effect of age on vigilance time .The effect was statistically significant ($p < 0.05$) with a positive correlation value of 0.0623.Similarly ANOVA tests were done to see the effects of education and social class on vigilance time. In case of education, there was statistically significant difference at $p < 0.05$ level and effect size was large (eta squared 0.39). Post hoc comparison using the Tukey HSD reveals that vigilance time is higher in Undergraduate students than all other groups. Other groups do not significantly differ from each other.

Regarding social class, there was statistically significant difference at $p < 0.05$ level and effect size was large (eta squared 0.12). Post hoc comparison using the Tukey HSD reveals that vigilance time is lower in upper middle class than other groups. Other groups do not significantly differ from each other.
No significant difference among different marital group found.

Independent sample t test done to compare mean Vigilance time in different groups of participants who were grouped according to their sex, religion, profession, and stream.
Statistically significant differences in means were found in different profession groups and stream groups only.
In other groups, no significant result found.

Categorical variables	Vigilance time in minutes Mean (SD)	t value
Sechi: Male	8.15(1.40)	0.94
Female	7.81 (2.69)	
Religion: Hindu	7.98 (2.15)	- 0.24
Muslim	8.11(1.42)	
Profession: Student	7.59 (2.53)	t = -2.149*
Teacher	8.36 (1.36)	
Stream: Science	8.41 (1.98)	t = 4.07**
Humanities	6.83 (1.89)	

*$p < 0.05$
** $p < 0.001$

Regarding profession, two groups, teacher and student were significantly different in mean vigilance time. Mean Vigilance time of students (M= 7.59, SD = 2.53) was significantly lower (mean difference -0.764, 95% CI (-1.49, -0.36) than that of teachers (M= 8.36, SD = 1.46),   t (df 130) = -2.149 , p< 0.05, two tailed.

Regarding stream, two groups, science and humanities were also significantly different in mean vigilance time.
Mean Vigilance time of science group (M= 8.41, SD = 1.98) was significantly higher (mean difference 1.582, 95% CI (0.81, 2.35) than that of humanities (M= 6.83, SD = 1.89) , t (df 130) = 4.07 , p< 0.001, two tailed.
To examine whether there is statistically significant difference in vigilance mistake with difference in social class or education status one-way between group ANOVA was done.

Independent sample t test done to compare Means of Vigilance mistake in different groups of participants who were grouped according to their sex, religion, marital status, profession, and stream.
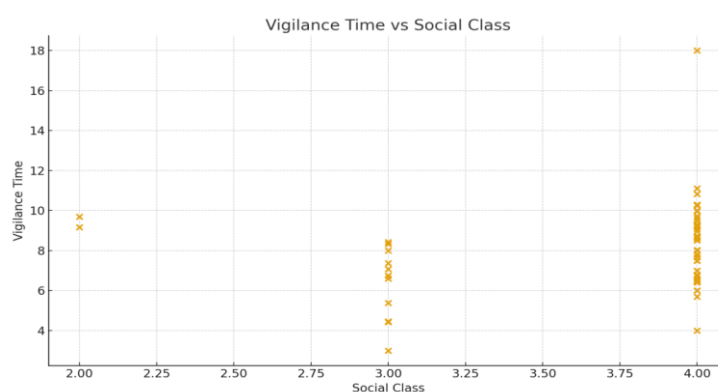No significant result found.

Additional Scatter Diagrams

Vigilance Time vs Age

Vigilance Time vs Education
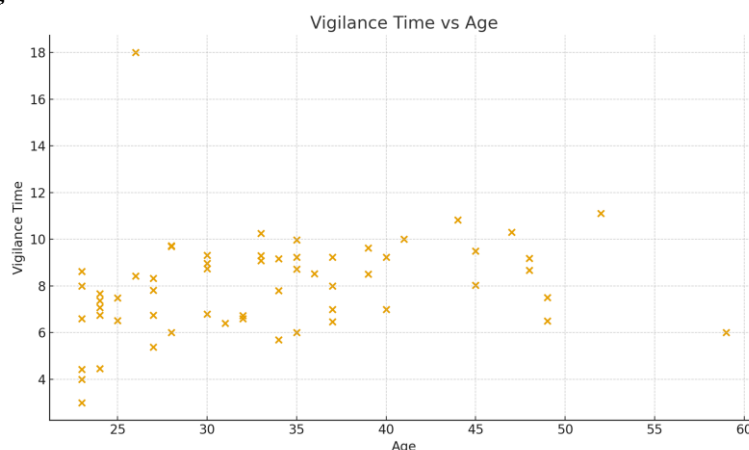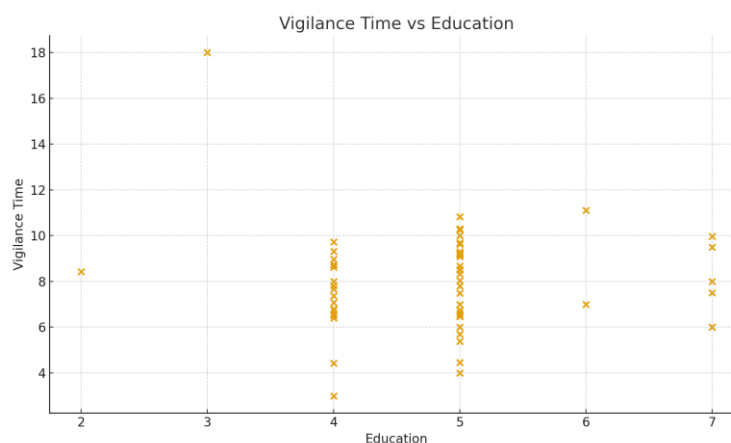
1=illiterate,2=high school,3=undergraduate,4=postgraduate student,5=Postgraduate ,6=Undergraduate teacher,7+postgraduate teacher

Vigilance Time vs Social Class

1=lower class,2=lower middle class,3=upper middle class,4=upper class

DISCUSSION

Findings from this study demonstrate that DVT performance is significantly influenced by age, education, stream and social class, while gender, residence and religion do not significantly affect vigilance outcomes.

These results are consistent with earlier neuropsychological studies suggesting that early educational exposure improves processing speed, attentional efficiency and executive functioning[13][15][21]

We found poorer score in DVT by undergraduate students which can only be explained by small sample size and need further exploration.

The significant association between social class and test performance aligns with earlier research showing that enriched environments, access to academic resources and cognitive stimulation support better attentional and vigilance functioning.[19][20]

We also found upper-middle class having best performance among all social classes.This may be due to the fact most of the professors belonged to the upper class and students fared better than professors with respect to vigilance time in our study. There is a strong association between profession and social class distribution in the study(P value<0.001)

Students demonstrated faster completion times than teachers, which may relate to ongoing academic engagement and younger age distribution, supporting evidence that frequent cognitive stimulation enhances sustained attention.

The faster performance among humanities stream participants contrasted with expectations based on standard executive functioning literature; however, this may reflect differences in task familiarity, testing anxiety, or implicit numeracy-based processing biases.[21][22]

Also novelty of task , less demanding work hours resulting in less continued stress, less fatigue and comparatively quality of sleep may explain partially the better performance of humanities students in our study as quite of few of our subjects(20) were Medical residents doing night duty. Effect of continued stress[11],fatigue[23] and sleep[25][26] on vigilance is well known.

Gender-neutral performance aligns with earlier literature suggesting minimal sex-based variation in vigilance or processing speed tasks.[16][17]

The lack of association between vigilance mistakes and demographic variables suggests errors may be less sensitive to cognitive differences than time- based metrics.Also accuracy is not that much affected by age as much as processing speed.[26]

Overall, this study reinforces the need for region- specific normative values for DVT interpretation. Application of foreign norms risks misclassification of impairment in Indian populations due to cultural, educational and socioeconomic variability.

Limitations:
Though it is a novel effort, at least in this part of country, it has several limitations.
- The sample size was small for a normative population-based study
- It disproportionately represented participants mostly from students and teachers of a medical college who are urban, highly educated individuals ,who do not represent normal population of our country.
- Younger adults were over represented, limiting age-related analysis.
- A single neuropsychological measure was used rather than a full battery.
- Though psychiatric illness was excluded from study by applying CGI-S, normal affective fluctuations may affect test result which was not considered.
- Cross-sectional design prevents examination of longitudinal cognitive changes

CONCLUSION
This study demonstrates that education and socioeconomic status significantly influence Digit Vigilance Test (DVT) performance, with higher education and better socioeconomic class associated with faster completion time. Gender, religion, residence and marital status did not significantly influence results. Students performed better than teachers, suggesting ongoing academic engagement positively affects sustained attention. Science students performed slightly slowly when compared to humanities probability due to fatigue, continued stress and poorer quality of sleep.

These findings emphasize the need for culturally and regionally appropriate normative data to ensure accurate clinical interpretation. The DVT remains a practical, culture-fair and clinically valuable measure for assessing sustained attention in the Indian population.
So, we need more elaborate studies from different linguistic-cultural regions of our country , so that the derived data can be used efficiently to differentiate pathology from normative status

REFERENCES:
1. Parasuraman R. Vigilance, monitoring, and search. *Varieties of Attention.* San Diego: Academic Press; 1984. p. 243–71.
2. Factors influencing sustained attention performance. *Int J Environ Res Public Health.* 2022;19:5216.
3. Sarter M, Bruno JP. Cortical cholinergic inputs mediating arousal essential for performance: relevance for ADHD and aging. *Neuropsychopharmacology.* 2002;27(2):253–72.
4. Oken BS, Salinsky MC, Elsas SM. Vigilance, alertness, or sustained attention: physiological basis and measurement. *Clin Neurophysiol.* 2006;117(9):1885–1901.
5. Kelland DZ, Lewis FR. The digit vigilance test: reliability, validity, and sensitivity to diazepam. *Arch Clin Neuropsychol.* 1996;11(4):339–44.
6. Rao SL, Kobaraiah M, Subbakrishna DK. *NIMHANS Neuropsychology Battery: Manual.* National Institute of Mental Health and Neurosciences; 2004.
7. Fabio RA, Capri T. The role of sustained attention in ADHD: a neuropsychological perspective. *Child Neuropsychol.* 2019;25(3):345–59.
8. Whyte J, Grieb-Neff P, Gantz C, Polansky M. Sustained attention in traumatic brain injury and healthy controls: enhanced sensitivity with dual task load. *Neuropsychologia.* 2005;43(8):1104–15.
9. Warden DL, Gordon B, McAllister TW. Vigilance impairment after traumatic brain injury: clinical implication for rehabilitation. *Brain Inj.* 2013;27:30–40.
10. Mass R, Wolf K, Wagner M, Haasen C. Differential sustained attention/vigilance changes over time in schizophrenics and controls during a degraded stimulus Continuous Performance Task. *Eur Arch Psychiatry Clin Neurosci.* 2000;250:24–30.
11. Ballard JC. Computerised assessment of sustained attention: A review of factors affecting vigilance performance. *J Clin Exp Neuropsychol.* 1996;18(6):843–63.
12. Deaton JE, Parasuraman R. Sensory and cognitive vigilance: effects of age on performance and subjective workload. *Hum Perform.* 1993;6:71–97.
13. Parasuraman R, Nestor PG, Greenwood O. Sustained-attention capacity in younger and older adults. *Psychol Aging.* 1989;4:339–45.

14. Last BS, Lawson GM, Breiner K, Steinberg L, Farah MJ. Childhood socioeconomic status and executive function in childhood and beyond. *PLoS One.* 2018;13(8):e0202964.

15. Rakesh D, Lee PA, Gaikwad A, McLaughlin KA. Annual research review: associations of socioeconomic status with cognitive function, language ability, and academic achievement in youth. *J Child Psychol Psychiatry.* 2024;66(4):417–39.

16. Dittmar ML, Warm JS, Dember WN, Ricks DF. Sex differences in vigilance performance and perceived workload. *J Gen Psychol.* 1993;120:309–22.

17. Goeppe T, Hayes M, et al. Sex differences in sustained attention performance and neuromuscular fatigue during an intense cognitive-motor dual task in normoxia and hypoxia. *Int J Sports Physiol Perform.* 2025;20(10):1393–1402.

18. Guy W. Clinical Global Impressions. *ECDEU Assessment Manual for Psychopharmacology.* 1976:218–22.

19. Obradovic J, Yousafzai AK, Finch JE, Rasheed MA. Maternal scaffolding and home stimulation: key mediators of early intervention effects on children's cognitive development. *Dev Psychol.* 2016;52:1409–21.

20. Korzeniowski C, Ison MS, Difabio H. Group cognitive intervention targeted to strengthening executive functions in children at social risk. *Int J Psychol Res.* 2017;10:34–45.

21. AlAbdulwahab SS, Kachanathu SJ, AlKhamees AK. Cognitive abilities of health and art college students: a pilot study. *J Phys Ther Sci.* 2016;28(5):1454–58.

22. Furnham A, Crumpo J. The sensitive, imaginative, articulate art student and conservative, cool, numerate science student: individual differences in art and science students. *Learn Individ Differ.* 2013;25:150–55.

23. Slimani M, Znazen H, Bragazzi NL, Zguira MS, Tod D. The effect of mental fatigue on cognitive and aerobic performance in adolescent active endurance athletes. *J Clin Med.* 2018;7:510.

24. Hudson AN, Van Dongen HPA, Honn KA. Sleep deprivation, vigilant attention, and brain function: a review. *Neuropsychopharmacology.* 2020;45(1):21–30.

25. Dichiit A, Thawani R, Goyal A, Vaney N. Psychomotor performance of medical students after 24 hours of sleep deprivation. *Indian J Psychol Med.* 2012;34(2):129–32.

26. Torrens-Burton A, Hanley CJ, Wood R, Basoudan N, Norris JE, Richards E, et al. Lacking pace but not precision: age-related information processing changes in response to a dynamic attentional control task. *Brain Sci.* 2020;10:390.