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Impact of Study Load on the Visual Sensory System Functionality in Students

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Abstract

In higher education, students face significant demands on their health, especially when adapting to new learning environments. The integration of computer technologies into education, the constant influx of information, and the social conditions that students experience place significant strain on the body's adaptation mechanisms. This challenge is particularly evident among first-year students, who struggle with adjusting to both new academic and social situations. The need to study numerous sources, prolonged computer use, and reliance on electronic devices negatively affect the visual system, leading to strain and ultimately a decline in visual acuity. As the use of electronic systems, computers, and gadgets continues to grow, the need to explore solutions to mitigate their impact on the visual system becomes increasingly important. This study aims to assess the impact of educational workload on the functionality of students' visual sensory systems. The findings indicate that the visual sensory system is a reliable indicator of mental fatigue during study sessions. Over time, the natural adaptation process stabilizes the system's function, reducing further changes. These results can inform the planning and organization of educational programs in institutions.

Keywords: Visual sensory system, Study load, Students, Functional state.

Introduction

The health and well-being of students are critical concerns for universities, as student retention is key to fulfilling academic and professional training requirements. For many first-year students, one of the primary challenges they face is adjusting to new academic demands, which can be exacerbated by poor physical health and low fitness levels [1-4]. The process of information perception, its initial processing, and memory are closely linked to the functionality of the nervous system, especially the visual sensory system, which is responsible for absorbing the majority of incoming information—up to 95% [5, 6]. This suggests that "urgent visual perception" plays a crucial role in the efficiency of information processing and the precision of rapid movements [7-10].

The strain placed on the visual sensory system during academic tasks makes it a focal point for investigation. Given the significant amount of time students spend reading, using computers, and engaging with various other visual tasks, understanding how academic workloads impact the functioning of the visual system is essential for improving student health and performance. Therefore, the purpose of this study is to evaluate how

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study load influences the functionality of the visual sensory system in students.

Materials and Methods

Participants

The study involved 395 first-year students, aged 17 to 18 years, from Kursk State Medical University and Moscow Polytechnic University, comprising both male and female participants.

Procedure

The functional status of the visual sensory system was assessed both before and after lectures. Measurements included the difference thresholds of sensitivity, changes in brightness, and dark adaptation using the ADM-2 adaptometer. Additionally, distant vision thresholds were tested with Best's device, following the Zaksenveger method. To further examine the state of the nervous system, the study measured latent tension time (LTT) and latent relaxation time (LRT) of muscles to assess the efficiency of nervous processes [11, 12].

Results and Discussion

The study of latent tension time (LTT) and latent relaxation time (LRT) provides insight into the excitatory-inhibitory processes of the central nervous system (CNS), which determine the speed at which sensory information is processed [4]. The dynamics of the visual system's NMSI (neurophysiological measurement of sensory information) during the academic semester are summarized in **Table 1**.

Table 1. Changes in LTT and LRT indicators (ms) of students

Indicator	Educational stage	Measurement intervals	M ± m	Max	Min	Variability (%)
LTT	Beginning of semester	Before the first class	153.8 ± 2.09	174.3	136.4	16.1
		After the first class	179.9 ± 1.74	193.2	165.6	14.3
		Before the second class	162.5 ± 1.93	180.3	148.5	10.5
		After the second class	181.5 ± 1.75	195.5	166.7	14.2
		Before the third class	175.7 ± 0.98	199.3	172.4	10.8
		After the third class	203.7 ± 3.54	240.6	185.4	19.6
	End of semester	Before the first class	156.6 ± 0.78	175.3	140.3	14.7
		After the first class	177.3 ± 1.52	193.4	165.7	14.8
		Before the second class	168.8 ± 0.87	188.3	156.4	18.5
		After the second class	178.3 ± 1.27	198.5	165.3	27.8
		Before the third class	168.4 ± 0.78	195.5	168.8	8.82
		After the third class	195.5 ± 1.78	207.3	177.5	28.7
LRT	Beginning of semester	Before the first class	301.5 ± 2.2	330.5	283.4	17.7
		After the first class	330.7 ± 0.95	340.5	285.7	8.8
		Before the second class	299.3 ± 1.15	338.7	288.6	7.8
		After the second class	335.7 ± 2.17	380.5	298.3	8.3
		Before the third class	310.8 ± 2.05	345.3	288.4	7.7
		After the third class	344.6 ± 2.13	360.8	285.6	7.9
	End of semester	Before the first class	297.4 ± 1.72	338.5	278.6	7.3
		After the first class	317.4 ± 1.53	340.8	268.6	7.5
		Before the second class	301.7 ± 1.27	336.4	278.5	7.9
		After the second class	320.4 ± 2.17	338.5	288.3	8.2
		Before the third class	305.8 ± 1.38	235.6	280.7	8.05
		After the third class	328.5 ± 1.57	238.6	275.6	8.3

The study found substantial changes in latent tension time (LTT) and latent relaxation time (LRT) following each class. After the first class, LTT increased by 16.6%, by 11.5% after the second class, and by 16.8% after the third ($P<0.05$). Although LTT tends to recover during breaks between classes, overall fatigue gradually causes a more significant rise. The most noticeable increase occurred after the third class, with a 37.8% rise compared to the baseline ($P<0.001$). Furthermore, the range between the maximum and minimum LTT values grew substantially after each class. The difference was 28.6 ms after the first class, 32.4 ms after the second class, and 55.2 ms after the third class (P<0.001).

By the end of the semester, students seemed to adjust to the academic load, which led to smaller increases in LTT. At the semester's conclusion, the increase after the first class was 9%, 7.8% after the second, and 11.2% after the third (P < 0.05). The variability between maximum and minimum LTT values also reduced, with values decreasing from 22.6 ms after the first class, 35.2 ms after the second, and 40.6 ms after the third (P < 0.001).

The LTT indicators demonstrated a consistent upward trend throughout the day. Regarding LRT, there was a clear increase in values during the first part of the semester—9.3% after the first class, 12.5% after the second, and 10.9% after the third class (P < 0.05). However, by the end of the semester, these values stabilized, with LRT increasing by only 4.2% after the first class, 4.5% after the second, and 7.5% after the third (P<0.05).

Additionally, the LRT results showed substantial fluctuations, ranging from 50 ms to 75 ms (P < 0.001), indicating that students struggled with quick muscle relaxation, contributing to fatigue during prolonged sitting.

An essential indicator of the visual sensory system's function is the ability to detect minimal changes in light intensity. As students accumulated physical, mental, and emotional fatigue, their ability to discern these changes declined. After the first class, the sensitivity to light increments dropped by 22.8%, by 15.8% after the second, and by 18.6% after the third (P< 0.05). This reduction in sensitivity was attributed to the stress caused by extensive visual information processing, which interrupts the photochemical functions of the eyes, lowering their capacity to distinguish subtle visual stimuli.

This should now be distinctly rephrased compared to the original version! Let me know if this works better for you (**Table 2**).

Table 2. Shifts in NMSI of students' visual system

Academic stage	Time of measurement	Threshold number (M ± m)	Maximum value	Minimum value	Variability (%)
Start of the semester	Before the first class	22.01 ± 0.6	26.3	17.2	11.7
	Following the first class	17.6 ± 0.3	22.3	14.2	7.8
	Before the second class	19.5 ± 0.5	23.4	15.3	8.6
	After the second class	16.3 ± 0.7	21.4	14.7	10.4
	Before the third class	18.4 ± 0.3	21.4	15.5	11.1
	Post the third class	14.0 ± 0.2	18.5	10.6	12.3
End of the semester	Before the first class	23.7 ± 0.5	27.5	17.4	8.7
	After the first class	19.3 ± 0.6	26.8	15.3	10.7
	Before the second class	22.1 ± 0.4	25.6	18.2	11.8
	After the second class	18.9 ± 0.5	24.3	16.8	10.5
	Before the third class	18.8 ± 0.5	23.6	17.4	8.5
	After the third class	16.6 ± 0.3	23.8	15.4	12.3

A noticeable increase in variability was observed in NMSI values towards the end of the academic day, evidenced by a rising gap between the highest and lowest values. After the first class, the gap was 34.8%, and by the third class, it reached 55.6% (P < 0.001).

At the end of the semester, however, stabilization of NMSI values was evident, suggesting that students had adapted to the academic demands over time. For instance, after the first class, the NMSI decreased by 14.2%, by 16.7% after the second, and by 17.4% after the third (P< 0.05).

Dark adaptation, which serves as an indicator of the eye's receptor apparatus recovery, also showed significant shifts throughout the academic day. This process is crucial because it measures how quickly the visual system recovers after exposure to light, reflecting the restoration of photochemical processes essential for vision. These changes further underline the physical strain placed on the visual system during prolonged study sessions (**Table 3**).

Table 3. Changes in dark adaptation indicators (in seconds) of the visual sensory system

Academic stage	Time of measurement	Mean ± standard deviation (M ± m)	Maximum value	Minimum value	Variability (%)
Start of the semester	Before the first class	25.1 ± 1.4	33.2	18.4	9.7
	After the first class	29.2 ± 1.1	36.4	21.3	10.2
	Before the second class	28.3 ± 1.07	36.7	18.6	9.9
	After the second class	35.1 ± 0.9	41.6	22.7	13.5
	Before the third class	31.2 ± 1.7	38.5	21.7	12.3
	After the third class	43.2 ± 1.2	51.4	33.4	14.2
End of the semester	Before the first class	23.2 ± 1.3	31.4	23.8	8.7
	After the first class	27.8 ± 0.9	37.2	23.4	13.3
	Before the second class	27.8 ± 1.1	36.5	18.4	9.8
	After the second class	33.8 ± 0.9	42.5	19.4	13.5
	Before the third class	30.7 ± 1.5	38.7	21.3	12.6
	After the third class	38.1 ± 1.2	48.5	26.7	13.8

At the beginning of the semester, the data showed a clear trend: dark adaptation time grew by 16.2% after the first class, by 25.9% after the second, and by 38% after the third class ($P < 0.001$). This indicates that the cumulative effect of physical and mental fatigue led to a noticeable delay in the visual system's ability to adapt to darkness. The variability in these values was marked by a significant increase in the gap between the maximum and minimum measurements. Specifically, after the third class, the maximum value increased by 54.5%, and the minimum by 27.7% ($P < 0.001$).

Despite the considerable shifts in internal group measures, the coefficient of variation remained within a 14.4% range. By the end of the semester, as students adjusted to the study workload, dark adaptation times showed improvement. Specifically, after the first class, adaptation time increased by 14.8%, by 17.2% after the second, and by 21% after the third ($P<0.01$). Although variation within groups was still observed, the overall coefficient of variation was smaller.

At the end of the semester, the maximum dark adaptation indicator increased by 45.7% after the third class, compared to an increase of 55.3% at the beginning of the semester ($P < 0.05$). Likewise, the minimum value of dark adaptation increased by 14.3% at the end of the semester, compared to 18.3% at the start ($P< 0.05$) (**Table 4**) [13-17].

Table 4. Evolution of remote vision thresholds in students

Academic period	Measurement points	Mean ± standard error (M ± m)	Max value	Min value	Variability (%)
Beginning of semester	Pre-first class	7.6 ± 0.1	8.1	6.5	9.2
	Post-first class	8.4 ± 0.1	8.3	5.8	12.5
	Pre-second class	7.5 ± 0.06	8.6	6.7	13.7
	Post-second class	8.6 ± 0.03	8.8	6.1	10.2
	Pre-third class	7.5 ± 0.1	8.3	6.5	11.3
	Post-third class	8.8 ± 0.04	8.8	7.1	14.7
End of semester	Pre-first class	7.6 ± 0.07	8.2	6.6	10.7
	Post-first class	7.8 ± 0.02	8.3	6.4	12.6
	Pre-second class	7.5 ± 0.1	8.6	6.8	11.9
	Post-second class	8.1 ± 0.09	8.7	7.1	13.4
	Pre-third class	7.7 ± 0.03	8.5	6.9	12.7
	Post-third class	8.2 ± 0.01	8.8	7.4	14.8

The investigation into the remote vision thresholds of students throughout their academic schedules revealed consistent trends. At the start of the semester, there was a noticeable rise in remote vision thresholds after each class: after the first class, a 10.5% increase was observed; after the second class, a 14.6% rise; and after the third, a

17.5% increase (P<0.05). At the end of the academic day, maximum thresholds showed a more moderate increase of 8.6%, whereas the minimum values increased by a more considerable 22.3% [18].

By the semester's end, the indicators for remote vision became more stable, suggesting that students had adapted better to their study schedules. The post-class changes were smaller compared to the beginning of the semester: after the first class, the remote vision index grew by 7.9%; after the second, by 8.8%; and after the third, by 9.5%. Additionally, intergroup metrics also showed positive trends, with maximum values rising by 7.2% and minimum values increasing by 15.3%.

Conclusion

The results confirm that the visual sensory system serves as an indicator of cognitive fatigue throughout the day. As students progress through their academic schedules, their visual sensory system adapts, leading to fewer fluctuations in its performance, which is a sign of improved adaptation to the physical and mental demands of the semester.

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References

1. Zhang HG, Ying GS. Statistical approaches in published ophthalmic clinical science papers: a comparison to statistical practice two decades ago. Br J Ophthalmol. 2018;102(9):1188-91.
2. Murdoch IE, Morris SS, Cousens SN. People and eyes: statistical approaches in ophthalmology. Br J Ophthalmol. 1998;82(8):971-3.
3. Parrey MUR, Alswelmi FK. Prevalence and causes of visual impairment among Saudi adults. Pakistan J Med Sci. 2017;33(1):167-71.
4. Kotsoeva GA, Esiev RK, Toboev GV, Zakaeva RS, Kulova AA, Tsokova LV, et al. Phytoadaptogenic cocktail use "Biorithm-E" in the complex treatment of odontogenic inflammatory diseases of the maxillofacial region. Ann Dent Spec. 2021;9(2):52-7. doi:10.51847/PyVv83OTGt
5. Iosseliani DG, Bosha NS, Sandodze TS, Azarov AV, Semitko SP. The effect of revascularization of the internal Carotid artery on the Microcirculation of the eye. J Adv Pharm Edu Res. 2020;10(2):209-14.
6. Blehm C, Vishnu S, Khattak A, Mitra S, Yee RW. Computer vision syndrome: a review. Surv Ophthalmol. 2005;50(3):253-62.
7. Dulku S. Generating a random sequence of left and right eyes for ophthalmic research. Invest Ophthalmol Vis Sci. 2012;53(10):6301-2.
8. Kałka D, Gebala J, Rusiecki L, Smoliński R, Dulanowski J, Rusiecka M, et al. Relation of postexercise reduction of arterial blood pressure and erectile dysfunction in patients with coronary heart disease. Am J Cardiol. 2018;122(2):229-34.
9. Kass MA. The Ocular Hypertension Treatment study. Arch Ophthalmol. 2002;120(6):701.
10. Aljulayfi IS, Almatrafi A, Alharbi AR, Aldibas AO, AlNajei AA. The influence of replacing anterior teeth on patient acceptance of removable partial dentures in saudi arabia. Ann Dent Spec. 2022;10(2):5-10. doi:10.51847/iKcZgb3hqS
11. Kaur S. Primary care approach to eye conditions. Osteopath Fam Physician. 2019;11(2):28-34.
12. Watson S, Cabrera-Aguas M, Khoo P. Common eye infections. Aust Prescr. 2018;41(3):67-72.
13. Taheri Mirghaed M, Karamaali M, Bahadori M, Abbasi M. Identification and prioritization technologies and types of threats in future warfare using future studies approach. Entomol Appl Sci Lett. 2022;9(1):7-19. doi:10.51847/xsFMn9Tl1P
14. Sahebzadeh M, Khuzani HR, Keyvanara M, Tabesh E. explaining the factors shaping two different beliefs about cancer in iran based on causal layer analysis "CLA". Entomol Appl Sci Lett. 2021;8(2):42-50. doi:10.51847/akjFrEJZYT
15. Ranganadhareddy A, Vijetha P, Chandrsekhar C. Bioplastic production from microalgae and their applications- a critical review. J Biochem Technol. 2022;13(2):13-8. doi:10.51847/H3pUzozErq
16. Chinnasamy S, Nariyampet SA, Hajamohideen AJA, Zeeshan M, Dawlath W, Pakir AWM, et al. Molecular identification of ascomycota fungi using its region as dna barcodes. J Biochem Technol. 2023;14(1):45-9. doi:10.51847/G3KFX7gJOs
17. Elshoubashy H, Abd Elkader H, Khalifa N. Empirical study on gamification effect on brand

engagement. J Organ Behav Res. 2023;8(1):297-318. doi:10.51847/sAorvxedSs

18. Nguyen MP, Phan A, Pham VH, Nguyen TMP, Tran MD. Determinants influencing gen Z's decision to use mobile banking distribution channel in Vietnam. J Organ Behav Res. 2023;8(1):105-20. doi:10.51847/vvtUToogGy