

COMPREHENSIVE STATISTICAL ASSESSMENT OF THE EFFECTS OF LIFESTYLE AND HEREDITARY FACTORS ON MEMORY AND VISUAL ACUITY

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Abstract: This article investigates and compares the effects of sleep duration, healthy nutrition, and time spent using smartphones on cognitive functions, particularly memory and attention, as well as on visual acuity in students and young professionals in the modern information environment, based on a questionnaire survey conducted among students. During the study, data were collected from 75 participants aged 19 to 39 using a specially developed Telegram bot and the Golovin chart.

Keywords: *memory, visual acuity, screen time, sleep duration, body mass index (BMI), hereditary factors, Golovin chart, cognitive activity.*

КОМПЛЕКСНАЯ СТАТИСТИЧЕСКАЯ ОЦЕНКА ВЛИЯНИЯ ОБРАЗА ЖИЗНИ И НАСЛЕДСТВЕННЫХ ФАКТОРОВ НА ПАМЯТЬ И ОСТРОТУ ЗРЕНИЯ

Аннотация: В данной статье на основе анкетирования, проведённого среди студентов, исследуется и сравнивается влияние продолжительности сна, здорового питания и времени, затрачиваемого на использование смартфонов, на когнитивные функции, в частности память и внимание, а также на остроту зрения студентов и молодых специалистов в современной информационной среде. В ходе исследования данные были собраны у 75 участников в возрасте от 19 до 39 лет с использованием специально разработанного Telegram-бота и таблицы Головина.

Ключевые слова: *память, острота зрения, экранное время, продолжительность сна, индекс массы тела (ИМТ), наследственные факторы, таблица Головина, когнитивная деятельность.*

Relevance of the Topic: In the 21st century, the intensive use of digital devices consumes an average of 7 to 8 hours of the daily routine of students and young professionals. Consequently, a reduction in sleep duration, hypodynamia (an increase in BMI), and an elevated information load are observed, which collectively exert a severe negative impact on cognitive functions.

Approximately 80% of the total information perceived by the human brain is processed through visual analyzers. Therefore, a decline in visual acuity is considered a critical factor that impairs memory consolidation and learning efficiency.

While the impact of screen time and sleep disturbances on cognitive performance is extensively covered in international scientific literature, there is a distinct lack of research simultaneously examining and comparing the effects of lifestyle and socio-hereditary factors on both visual acuity and cognitive function among medical students in Uzbekistan.

Objective of the Study: To conduct a comprehensive statistical evaluation of the impact of lifestyle factors (screen time, sleep patterns) and socio-genetic factors (parental education level) on memory, attention, and visual acuity.

Research Tasks:

1. To assess the improvement dynamics in repeated memory test scores.
2. To determine the correlation between visual acuity and screen time.
3. To analyze the association between sleep duration and memory scores.
4. To compare the study groups based on age and memory performance.
5. To evaluate the genetic association between parental educational attainment and offspring memory scores.

Materials and Methods: The study was conducted among 75 university students (46 females and 29 males) aged 19 – 39 years across various academic cohorts. Data collection was carried out between April 23 and April 30, 2026. Participants were stratified into distinct groups based on their study participation criteria (Table 1). The obtained data were statistically analyzed, compared, and subjected to correlation analysis.

A custom-developed Telegram bot was utilized to administer the research questionnaire and assessments. This digital tool was specifically engineered for a scientifically grounded, comprehensive evaluation of memory, attention, and cognitive processes. The testing protocols are strictly based on the established principles of modern cognitive psychology and neuropsychology. The assessment framework comprised a total of 30 items divided into three distinct modules of 10 tasks each:

- Visual memory: Graphic illustrations depicting various objects presented for 40 seconds;
- Auditory memory: Audio recordings broadcast for 30 seconds;
- Sequential memory: Various numerical sequences displayed for 40 seconds.

In accordance with standardized psychometric procedures, participants were allocated an average of 4 seconds to respond to each prompt. Based on the final cumulative scores, participants were classified into five distinct performance categories, and personalized medical recommendations were provided based on their questionnaire outcomes.

Visual acuity was assessed using the standard Golovin ophthalmological chart. Following standard clinical examination protocols, the evaluation was conducted from a distance of 5 meters, with normal visual acuity defined as $V = 1.0$

Group	Number of Students	Cognitive Data	Visual Acuity	Repeated Testing	Screen Time
201	14	Full participation	Full participation	8 students from this group participated	Full participation
302	11	No participation	Full participation	No participation	Full participation
505	33	Full participation	No participation	No participation	Full participation
Master's Students	14	Full participation	No participation	No participation	Full participation
Students from Other Groups	3	Full participation	No participation	No participation	Full participation

Table 1. Stratification of study participants and data availability across groups.

The investigation of cognitive processes and their influencing factors remains a central focus of modern neurobiology and psychology. Specifically, while Baddeley (2003) elucidated the

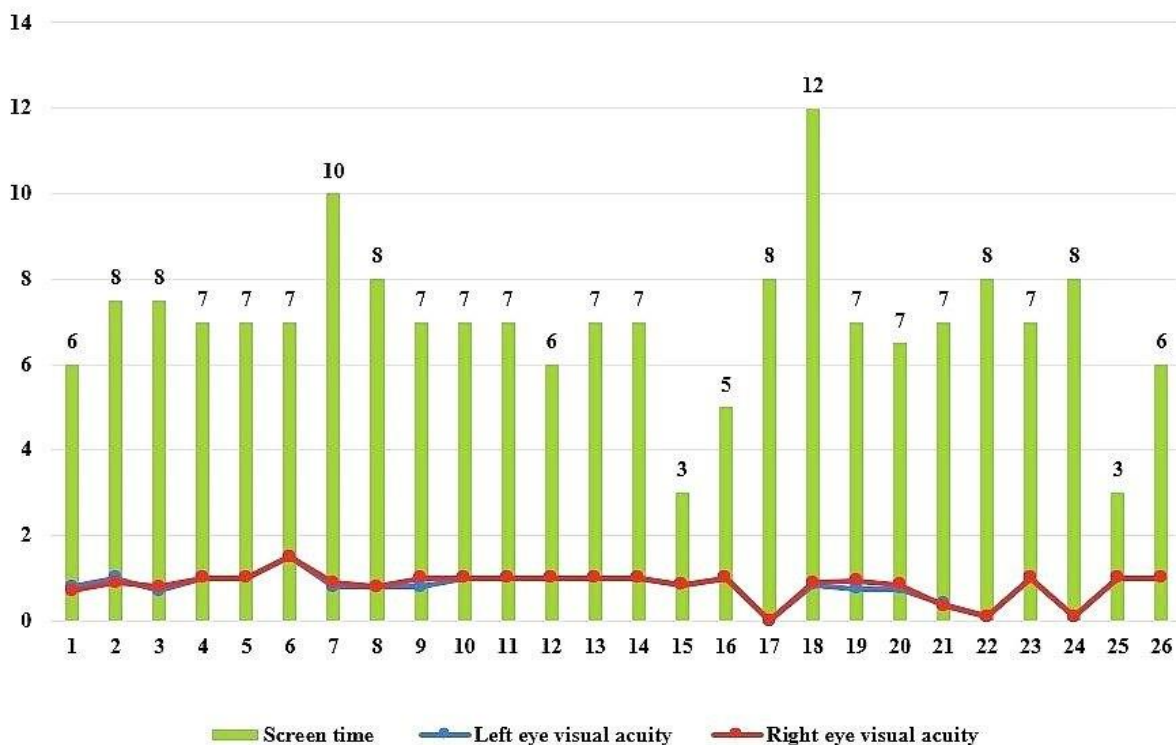
mechanisms of temporary information storage within his working memory model, Kandel (2013) demonstrated that memory formation is directly linked to synaptic plasticity. Furthermore, the vital role of sleep in memory consolidation has been extensively documented in the studies conducted by Stickgold (2005) and Walker (2009). With the rapid advancement of digital technologies, the consequent increase in screen time has been highlighted by Twenge and Campbell (2018), as well as Bozzola (2022), as a contributing cause to ocular strain, visual system fatigue, and the impairment of cognitive functions in young individuals. Additionally, the integral role of both genetic and socio-environmental factors in the development of attention and memory is well-reflected in the research of scholars such as Turkheimer (2003) and Nobre and Plomin (2016).

Statistical Analysis: Data were summarized using descriptive statistics. Pearson's correlation coefficient (r) was employed to identify associations. Repeated measures were evaluated using a paired t-test.

Results: In the dynamics of repeated measures, 8 participants from Group 201 completed a follow-up memory test after a brief interval, recording a score approximately ~53% higher than their initial average total memory score.

The visual acuity assessment involved 26 students from various cohorts. Examination of the right eye revealed normal visual acuity ($V \geq 1.0$) in 13 students, a mild impairment ($V = 0.70 - 0.95$) in 9 students, and a severe impairment ($V \leq 0.39$) in 4 students. When evaluated in the left eye, 13 students exhibited normal visual acuity, 9 showed a mild impairment, 1 demonstrated a moderate impairment, and 3 presented with a severe impairment.

A comparison between visual acuity metrics and screen time (Figure 1) indicated that students with normal visual acuity used mobile devices for an average of 6 hours daily. Conversely, students exhibiting mild, moderate, and severe visual impairments reported an average daily



mobile device usage of 8 hours. Stepwise calculation of these variables using Pearson's formula revealed a very high coefficient of determination, indicating a strong correlation.

Figure 1. The impact of personal mobile device usage time on visual acuity.

A total of 63 students participated in the analysis of the association between sleep duration and memory scores (Figure 2). Based on the memory test results, 7 students achieved an "excellent" score by successfully completing 90 – 100% of the assigned tasks. Furthermore, 11 students demonstrated a "very good" performance (80 – 89%), 23 students showed a "good" result, 12 students were graded as "satisfactory", and the remaining 10 students recorded a "poor" outcome. In terms of sleep duration, the 63 participants were stratified into three distinct categories. Thirty-seven students reported a normal sleep duration (7 – 8 hours), achieving an average memory test score of 65.5%. Nine students reported prolonged sleep (9 – 10 hours), with an average memory score of 62.6%. Finally, 17 students reported insufficient sleep (5 – 6 hours), which corresponded to an average memory score of 59.6%.

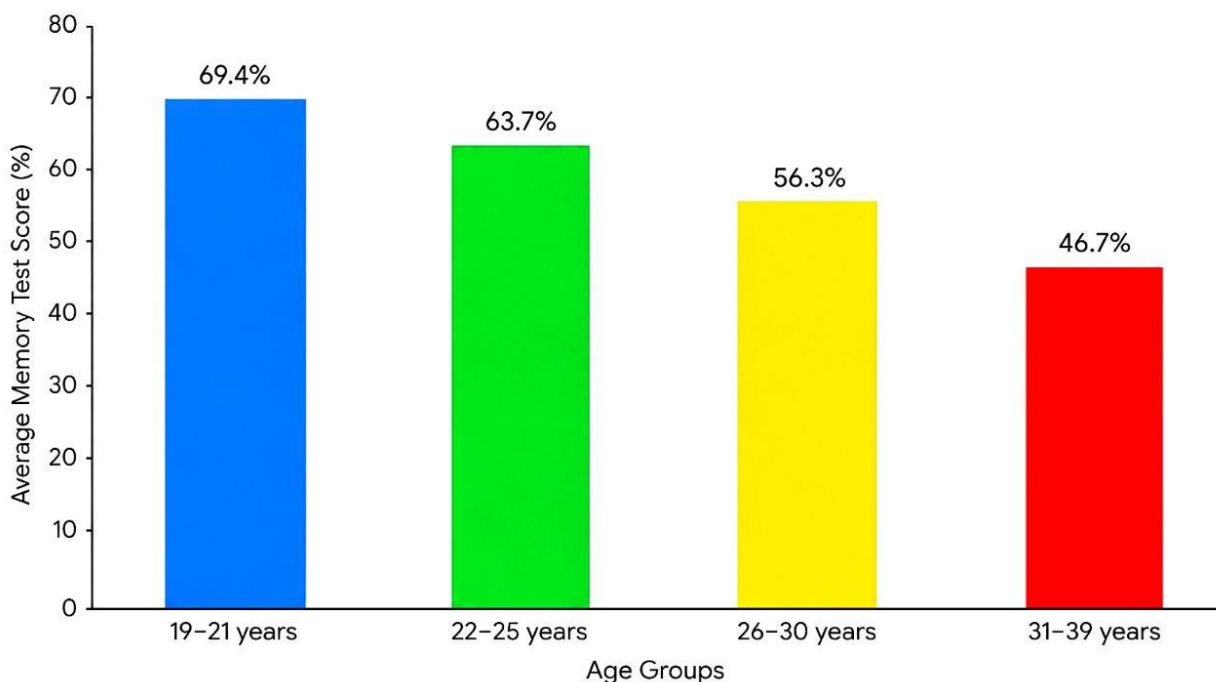
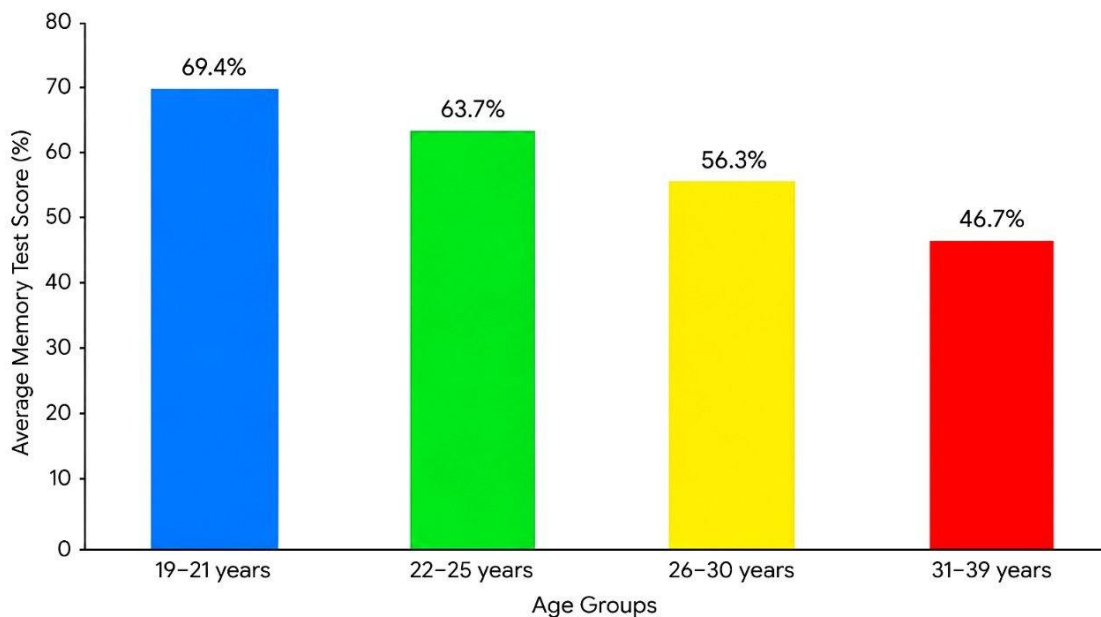


Figure 2. The impact of sleep duration on memory performance.

When correlating age with memory performance (Figure 3), 12 students aged 19 – 21 years achieved an average memory test score of 69.3%. Furthermore, 41 students aged 22 – 25 years scored 63.7%, 9 students aged 26 – 30 years recorded 56.3%, and one student in the 31 – 39 age bracket registered a score of 46.7%. This age-based stratification revealed a highly significant pattern. The study observed a discernible decline in the performance of short-term memory tasks as age increased (dropping from 69.4% to 46.7%).

Figure 3.
The



correlation between human age and memory retention.

Conclusion and recommendations

Based on the conducted experimental research and statistical analyses, the following fundamental conclusions were reached: the results of the repeated memory test indicate that the final score was higher compared to the initial average memory score of the students. This metric provides comprehensive practical evidence that systematically repeating information can significantly strengthen human memory and exponentially increase the retention stability of acquired data.

The impact of screen time on visual acuity: Upon analyzing the data, it was determined that students with normal visual acuity ($V=1.0$ and higher) used mobile devices for an average of 6 hours daily. However, in students with mild, moderate, and severe visual impairment, this metric averaged 8 hours per day. This demonstrates that prolonged screen time is one of the factors negatively affecting visual function.

According to the results of the study conducted to investigate the impact of sleep duration on students' cognitive functions, normal sleep (7 – 8 hours) was found to be the most effective for memory performance (average score of 65.5%). Exceeding the normal sleep duration (9 – 10 hours) or having insufficient sleep (5 – 6 hours) leads to a decline in memory performance to 62.6% and 59.6%, respectively.

Based on the analyses of our study, an inverse relationship exists between age and memory. Specifically, it was observed that as age increases, the efficiency of rapid information acquisition and retention naturally declines.

When examining available sources regarding the genetic association between parental educational level and offspring memory scores, it was observed that memory capacity depends more on the student's own lifestyle than on heredity or parental educational level.

Based on the research conclusions, the following practical recommendations are proposed to properly organize students' academic activities and maintain their cognitive health:

Adherence to optimal sleep hygiene: It is necessary to conduct awareness campaigns among students regarding the maintenance of daily sleep duration at the physiological norm of 7 – 8 hours, as chronic sleep deprivation or excessive sleep significantly diminishes memory performance.

Proper control of the study regimen: It is necessary to abandon continuous unstructured mental workloads of 3 – 4 hours during the educational process and instead implement a system of short breaks after every 1 – 2 hours of study. Enhancing the active assimilation of information by considering the impact of the age factor on cognitive characteristics. For this purpose, it is essential to widely use various visual and practical components (graphic diagrams, multimedia presentations, videos, and special notes) along with mnemonic methods and repetitive educational materials during classes. Global experts in pedagogy and neuropsychology have acknowledged that structuring the educational process in this manner significantly improves memory.

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