

Comparative Analysis Of Visual Efficiency, Eye Comfort And Visual Functions Among Mobile Active Gamers And Sportspersons

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ABSTRACT

Background:

Visual skills such as accommodation and convergence play important roles in ensuring optimal vision at close distances. Owing to the rising popularity of digital devices, especially mobile games, there have been notable reports of patients complaining about various visual disturbances. Prolonged screen usage has been linked to symptoms of visual fatigue, poor accommodation and convergence. In this regard, athletes will perform optimally owing to minimal screen exposure.

Method:

This cross-sectional study involved a total of 96 subjects from NIMS Hospital Jaipur, Rajasthan, of which 48 were mobile gamers and 48 were sports players who met the inclusion criteria. All the subjects were subjected to an eye examination by an optometrist, involving visual acuity, accommodative facility, Near Point of Convergence (NPC), Near Point of Accommodation (NPA), Intraocular Pressure (IOP), and Schirmer test for tear secretion.

Result:

The results highlighted major disparities in vision capabilities between the mobile active gamers and sportspersons. The sportspersons exhibited greater vision capability, showing enhanced accommodative capability (10.38 ± 1.75 cycles per minute (CPM)) relative to mobile gamers (7.94 ± 0.86 CPM), as well as enhanced NPC and NPA scores ($p < 0.05$). On the other hand, mobile active gamers displayed elevated intraocular pressure levels and decreased tear secretion rates, suggesting higher visual stress. A considerable correlation existed between excessive screen usage and impairments in accommodation and convergence functions ($p < 0.05$).

Conclusion:

The research indicates that Mobile active gamers suffer from visual inefficiency, accommodation insufficiency, and convergence insufficiency as a result of long-term screen use. In contrast, Sportspersons possess improved visual function and comfortable eye status. Such results highlight the importance of a physically active lifestyle and reduced screen time for the proper functioning of the visual system.

Keywords: Near Point of Convergence (NPC), Near Point of Accommodation (NPA), Intraocular Pressure (IOP), Screen Time, Mobile Active Gamers, Sportspersons.

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INTRODUCTION

The advent of technology and gaming is a vital aspect of present-day living, as it provides recreation and mental

engagement while fostering social interactions in every generation. Generally, gaming could either refer to physical games or digital/mobile games. The two types

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of games exhibit considerable differences regarding bodily involvement, visual requirements, and visual skills.⁽¹⁾

Physical games require constant bodily activities through the integration of the sensory organs and motor skills. On the other hand, mobile/digital gaming involves playing on digital gadgets like smartphones, tablets, and computers from a stationary position. It requires more visual effort than playing physical games, especially when performing near visual tasks.⁽²⁾



Fig 1 Sportspersons and Mobile Active Gamers
(Source: NIMS University)

Digital screens have been known to cause several visual problems, such as visual fatigue, diminished accommodative function, and binocular vision impairment. Focusing on close objects continuously exerts strain on the accommodation function, thus causing imbalance between accommodation and convergence. As a result, one may experience eye discomfort, headaches, blurry vision, and reduced visual quality.^(3,4)

On the contrary, sportspersons indulge in activities which demand a lot of visual efficiency coupled with physical efficiency. Sportsmen depend heavily on vision as they have to analyze and interpret dynamic visual input so as to be able to execute movements correctly. Research indicates that sportsmen have greater visual abilities than

their non-sports counterparts. They include better dynamic visual efficiency, depth visualization, peripheral visualization, and eye and hand coordination.⁽⁵⁾

Visual requirements for sporting activities entail quick and efficient shifts of vision focus, fast and accurate tracking of dynamic objects, and efficient coordination of the eyes and body. All these contribute to increased visual efficiency and efficient accommodative and convergence efficiency. Moreover, physical exercise enhances the circulation of blood within the eye system and hence improves the overall visual efficiency.^(4,6)

On the other hand, active mobile gamers are commonly faced with extended periods of near work and screen viewing. Such activities cause an additional burden on vision systems. Extended screen viewing may contribute to a lower blink rate, causing dry eyes and instability in the tear film. Moreover, sustained near work may adversely affect the near point of convergence and the near point of accommodation, thus compromising visual effectiveness.^(7,8)

The rising popularity of smartphones, particularly among the young generation, has generated a number of concerns related to their effect on eye health. High amounts of screen viewing have proven to impair accommodation as well as binocular function and induce visual discomfort. On the contrary, people who practice sports have proven to exhibit high visual efficiency.^(2,4,9) Thus, it is crucial to compare the visual function performance of mobile gaming enthusiasts and athletes to assess the effects of screen time on visual efficacy and eye comfort. The objective of this research is to examine and compare visual functions like visual acuity, accommodation, convergence, intraocular pressure, and tear production in the above-mentioned groups.^(10,11)

METHODS

This study is carried out as a cross-sectional comparative study to analyze and compare visual performances between sportspersons and mobile active gamers. This study was conducted in NIMS Hospital, Jaipur, Rajasthan. There were 96 subjects, including 48 sportspersons and 48 mobile active gamers, in the study. The subjects have been selected on the basis of availability and their willingness to take part in this study. The duration of the study was three months. Subjects aged between 18–30 years took part in this study. Those who were involved in sports for more than 2 hours a day were considered as sportspersons.⁽¹²⁾ Whereas those who used smartphone games for more than 4 hours a day were

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considered as mobile active gamers. Subjects who had ocular disease like keratoconus, glaucoma, retinopathy, prior ocular surgery or trauma, and any systemic condition that affects vision were excluded from the study. Furthermore, those who were under any vision therapy or had any clinical binocular anomalies were not included in the study. (27,28)

All participants were enrolled following the provision of relevant information about the objectives and methods of this investigation. They gave their signed consent before the data collection process began. Basic demographic information such as age, gender, and group was documented. Clinical guidelines were strictly adhered to, and an optometric assessment was carried out to test for visual functions. (13) Visual acuity at distance and near was quantified using Snellen charts in standard lighting. An objective refraction process was completed using retinoscopy, while subjective refraction was used to measure the best corrected visual acuity. (16,31) The accommodation was measured via near point of accommodation using the Royal Air Force rule and accommodative facility via ± 2.00 D flipper lenses at 33cm (CPM). (14) The evaluation of binocular vision took place via the near point of convergence. Non-contact tonometry was used to quantify the intraocular pressure (IOP). (29) Schirmer's test without a topical anaesthetic was utilized to measure tear production. (30) Parameters of interest include visual acuity, accommodative facility, Near Point of Convergence (NPC), Near Point of Accommodation (NPA), Intraocular Pressure (IOP), and tear secretion. Analysis was done using statistical methods such as mean, standard deviation, unpaired t-test, and chi-square test.

RESULT

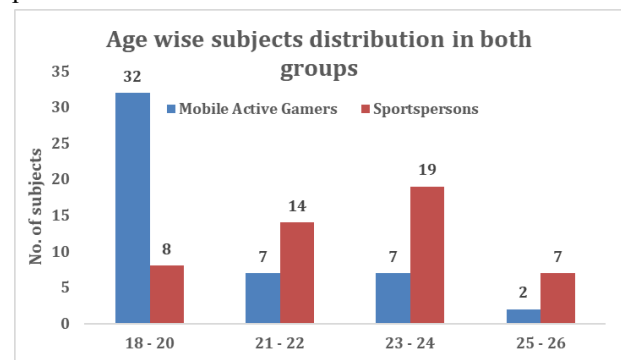
In the current research, the sample was constituted by 96 subjects: 48 of mobile active gamers and 48 sportspersons. Subjects were classified into two groups according to the degree of physical activity and amount of time spent before the screen. Mobile active gamers referred to people who spend their time playing with smartphones; sportspersons, on the other hand, were actively involved in sports activities.

The following discussion and conclusions will be made upon analyzing the comparison between different visual function parameters for both groups. The data obtained have been carefully analyzed statistically and presented in table form below. The parameters that will be analyzed include visual acuity, accommodative facility, near point of convergence (NPC), near point of accommodation

(NPA), intraocular pressure (IOP), and tear secretion (Schirmer test).

AGE DISTRIBUTION OF PARTICIPANTS

Age Distribution (Graph 1) revealed a statistically significant variation between the mobile active gamers and sportspersons ($\chi^2 = 25.05$, $p < 0.0001$). A significant number of mobile active gamers (66.7%) were from the young age bracket of 18–20 years old, implying that mobile addiction was more common in the young population. Sportspersons, on the other hand, exhibited a relatively even distribution in all the higher brackets, with the largest number of people being found in the age bracket of 23–24 years old (39.6%). These results point to the possibility that sportspersons were generally older and well-disciplined, while the young people indulged in mobile gaming. The highly significant value of p signifies that the age variation was not by mere coincidence but could contribute to the visual performance results.

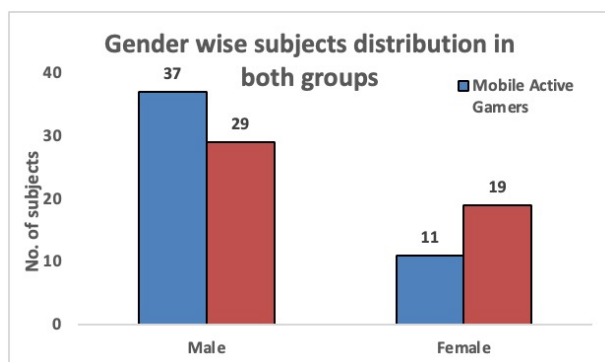


Graph 1: Age Distribution of Participants

GENDER DISTRIBUTION

When analyzed based on gender (Graph 2), it was found that most respondents in both groups were males. Among mobile active gamers, males comprised 77.1%, while among sportspersons, there were 60.4% males and a considerable percentage of females at 39.6%. Though there seems to be a difference in the distribution of gender, the results of the statistical analysis have shown that there is no significant difference ($p = 0.0782$). This means that gender was not a crucial factor in determining the impact of visual function.

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Graph 2: Gender Distribution

DESCRIPTIVE STATISTICS OF VISUAL FUNCTIONS

The description of visual performance (Table 1) characteristics showed that sportspersons always had better visual skills than mobile active gamers. Median accommodative facility was significantly higher in sportspersons (10.14 CPM) in comparison with gamers (8 CPM). This suggests the high skill of fast changes in eye focus, which is necessary for visual tasks' performing. Near point of convergence (NPC) value was also better (in terms of lower value) in sportspersons (7 cm) in comparison with gamers (8 cm). Lower NPC value denotes higher binocular control. The near point of accommodation (NPA) also demonstrated somewhat better results in sportspersons. Therefore, sportspersons had higher binocular and accommodative control than mobile gamers. It could be stated that being physically active promotes the development of binocular and accommodative control, whereas being engaged in activities with screens decreases their efficiency.

Table 1: Descriptive Statistics of Visual Functions

Variables		Minimum	Maximum	Median (IQR)
Age (In Yrs.)	Mobile Active Gamers	18	26	20 (19-22)
	Sportspersons	18	26	23 (22-24)
Accommodative Facility (CPM)	Mobile Active Gamers	6	9	8 (7-9)
	Sportspersons	7	14	10.14 (9-12)
NPC	Mobile Active Gamers	6	12	8 (7-9)

	Sportspersons	6	8	7 (6-7)
NPA	Mobile Active Gamers	6	12	8 (7-10)
	Sportspersons	6	9	8 (7-8)

IOP AND TEAR SECRETION

In the analysis of IOP (Table 2), it was observed that the mean value of IOP in active gamers was significantly higher than in sportspersons in both eyes. High IOP can be considered due to increase near work and continuous visual stress in gamers. While the IOP was within normal limits, the trend is indicative of a high level of visual stress. On analyzing tear secretion in both groups using the Schirmer test, the mean value of tear secretion in sportspersons was significantly higher (27.5 mm) than in gamers (22 mm). This signifies an increased risk for dry eyes in gamers due to lower blinking frequency.

Table 2: IOP and Tear Secretion

Variables		Minimum	Maximum	Median (IQR)
IOP (OD)	Mobile Active Gamers	13	23	16 (13.9-17.8)
	Sportspersons	12	18.2	14.15 (13.28-16)
IOP (OS)	Mobile Active Gamers	11.5	23	16.2 (14.2-17.5)
	Sportspersons	12	18.6	14.25 (13.83-16.3)
Schirmer test-1 (OD)	Mobile Active Gamers	10	28	22 (20-25)
	Sportspersons	20	30	27.5 (25-28.25)
Schirmer test-1 (OS)	Mobile Active Gamers	10	28	22 (20-25)
	Sportspersons	20	30	27.5 (25-28.25)

COMPARISON OF VISUAL FUNCTIONS (UNPAIRED T-TEST)

Results of statistical analysis of unpaired t-test (Table 3) showed highly significant variations in all parameters of

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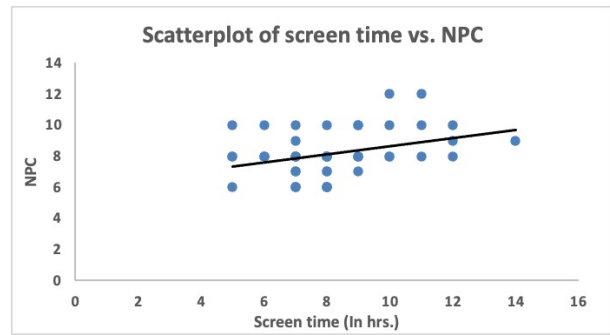
vision among both the groups ($p < 0.05$). It was found that sportspersons had a much better accommodative facility, which means improved focusing ability. Also, NPC results showed significant improvement, suggesting improved convergence ability and binocularity. Significant better NPA values among sportspersons suggest an efficient accommodative response, further proving the hypothesis that a physically active life improves visual functioning.

Table 3: Comparison Of Visual Functions (Unpaired T-Test)

Variables	Mobile Active Gamers Mean \pm SD	Sportspersons Mean \pm SD	Unpaired t-test	P-Value	Significance
Age	20.48 \pm 2.20	22.46 \pm 2.07	-4.53	< 0.001	All are Significant
Accommodative Facility (CPM)	7.94 \pm 0.86	10.38 \pm 1.75	-8.68	< 0.001	
NPC	8.17 \pm 1.51	6.75 \pm 0.67	5.96	< 0.001	
NPA	8.33 \pm 1.43	7.63 \pm 0.64	3.12	0.024	

SCATTERPLOT OF SCREEN TIME VS. NPC

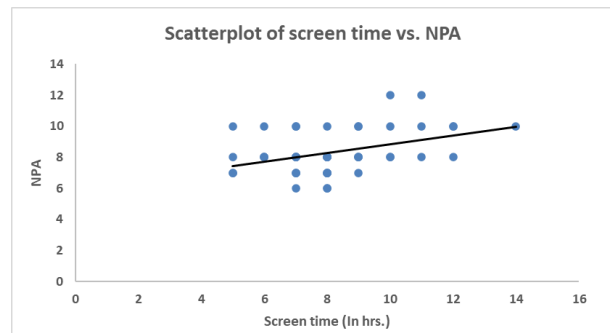
From the scatter diagram (Graph 3), it is evident that there exists a positive relationship between screen time and the near point of convergence. An increase in the amount of time spent on screens corresponds with an increase in NPC values outside the normal range. The higher NPC value denotes the lower degree of convergence efficiency and binocular control. Even though there are some variations in the distribution of the dots, the overall trend clearly shows that the near visual activities such as playing mobile games put a lot of strain on the vergence system, resulting in conditions such as convergence insufficiency like eye fatigue, double vision, and difficulties in sustaining binocular vision when working up close.



Graph 3: Scatterplot of screen times vs NPC

SCATTER PLOT: SCREEN TIME VS NPA

The scatter graph (Graph 4) below depicts a direct linear correlation between screen time and near point of accommodation (NPA). With an increase in screen time, the value of NPA increases as well, suggesting that the nearest distance at which clear sight can be achieved is moving farther away. It shows less accommodative ability and efficiency. Engaging oneself continuously in close work, like mobile games, could induce accommodative fatigue caused by constant ciliary muscle stimulation. This will eventually lead to diminished accommodative capability, poor vision of near objects, and asthenopia symptoms.



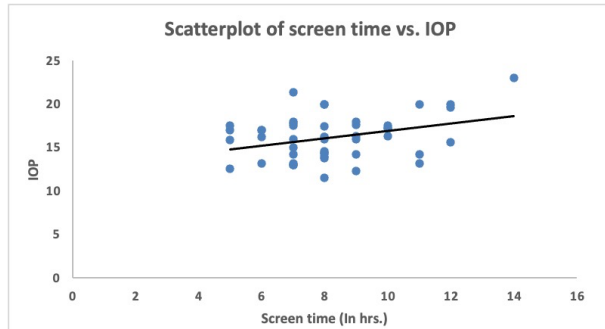
Graph 4: Scatterplot of screen time vs NPA

SCATTER PLOT: SCREEN TIME VS IOP

As can be seen from the scatter diagram above, there exists a moderate positive correlation between the screen time and the intraocular pressure (IOP). With an increase in the screen time, there is a slight likelihood of increasing the values of intraocular pressure. Even though the points plotted are quite scattered, the regression line implies that there exists some relationship. The rising values of IOP could be as a result of sustained fixation, lower blinking frequencies and stress of the eye during the use of screens. But since the

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correlation is very weak, then screen time cannot be said to have a very strong influence on IOP.



Graph 5: Scatterplot of screen time vs IOP

DISCUSSION

The above study was done using 96 participants, comprising 48 mobile active gamers and 48 sportspersons, in order to establish the difference in their visual performance. The results indicated that there were marked differences in accommodation, convergence, intraocular pressure, and tear film stability, among others.

Accommodation and Convergence

The findings from the current study indicated that athletes had improved accommodative capacity as well as convergence when compared with gamers who use mobile phones. The athletes had a greater accommodative facility (10.38 ± 1.75 CPM) compared with gamers (7.94 ± 0.86 CPM). Recession in NPC and enhancement in NPA among gamers suggest a lower capability for both convergence and accommodation. These findings align with earlier research^(17,18,27), where it was found that long hours spent gaming and engaging in near tasks result in accommodative fatigue and abnormalities in binocular vision. Lee *et al.*, (2019)⁽²⁷⁾ found that persistent gaming affects binocular vision functions, while Jorge *et al.*, (2025)⁽¹⁸⁾ showed the distinctions in visual performance in esports gamers and athletes. Moreover, Lam *et al.*, (2025)⁽¹⁷⁾ found higher visual strain and musculoskeletal stress in mobile esports gamers.

Impact of Screen Exposure on Visual Skills

From the result of the correlation analysis done in this research, higher screen exposure has been seen to affect negatively NPC and NPA, implying poor convergence and accommodative amplitude, but accommodation did not correlate significantly. This study result matches with previous research^(16-18,27) that links high screen exposure with computer vision syndrome, thus low binocularity. Additionally, Argilés *et al.*, (2022)⁽²⁴⁾ and Fogt *et al.*,

(2021)⁽²⁵⁾ pointed out that esports players exhibit altered visual and ocular properties from screen exposure.

Intraocular Pressure

In the current study, it was observed that the IOP levels were relatively higher among the mobile gamers than the sportsmen, though they all fell within the physiological norm. The weak positive relationship between the number of hours spent looking at screens and intraocular pressure shows that prolonged near vision can result in slight ocular stress.⁽¹⁹⁾ This hypothesis is evidenced by studies conducted by Read *et al.*, (2024)⁽¹⁹⁾, who established that the process of prolonged accommodation during close-range vision can result in a temporary elevation of intraocular pressure due to variations in ciliary muscle contraction and choroidal thickness. In addition, according to Choi *et al.*, (2019)⁽²⁸⁾, the process of prolonged near vision can cause short-term variations in intraocular pressure, which can be linked to variations in the flow of ocular blood and biomechanical characteristics within the eye. Overall, it can be argued that even though the elevation of intraocular pressure caused by near work using screen devices is temporary and within the normal physiological range, prolonged near vision can affect the processes within the eye. Therefore, constant exposure to screens, which is common among mobile gamers, can have an impact on intraocular dynamics.⁽²⁸⁾

Tear Film Condition

In the present investigation, there were significantly lower tear volumes in mobile gamers than in sportspersons, suggesting an increased chance of having dry eye complaints. This may be because gamers have a lower blinking frequency while engaging with the computer screen, causing unstable tear film. This evidence is highly consistent with previous studies.^(21,27) First, Chaiwiang *et al.*, (2024)⁽²¹⁾ stated that there was a higher frequency of dry eye symptoms and computer vision syndrome among esports players. Next, according to Lee *et al.*, (2019)⁽²⁷⁾, extended exposure to video games led to low blinking frequency and ocular surface problems.

CONCLUSION

In the current study, two groups of subjects (a total of 96 participants) have been chosen for the assessment of their visual function. In particular, 48 active mobile gamers and 48 sportspersons have been enrolled in the study, which provided data regarding the superior visual performance of sportspersons compared to mobile gamers. Namely, sportspersons showed significantly

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higher accommodative facility (10.38 ± 1.75 CPM) compared to mobile gamers (7.94 ± 0.86 CPM). Moreover, sportspersons possessed higher values concerning NPC and NPA parameters ($p < 0.05$). These data prove that excessive near work can be associated with accommodative fatigue and decreased binocular performance. Sportspersons, in contrast, are likely to demonstrate good visual function because of their active lifestyle and dynamic visual tasks they perform. It has also been revealed that mobile gamers had significantly higher values of intraocular pressure in comparison with sportspersons. However, they were within normal limits. Moreover, a significant decrease in tear secretion has been observed among mobile gamers, what made them prone to dry eye symptomatology. Finally, correlation analysis has shown a negative correlation between the parameters related to near visual acuity (NPC and NPA) and duration of screen time ($p < 0.05$).

COMPETING INTERESTS

The author declares that there are **no competing interests regarding the publication of this study.**

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