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IMPACT OF SCREENTIME ON VISUAL COMPETENCE AMONG UNIVERSITY KABADDI PLAYERS: A CROSS-SECTIONAL APPROACH

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Abstract

Background: *Excellent sensorimotor integration is essential for Kabaddi, a game that demands rapid decision-making, remarkable agility, and accurate motor abilities due to its strong physical contact. Oculomotor function, one of the sensory systems essential to athletic success, is critical for maintaining postural control and controlling effective vision. The influence of oculomotor characteristics on postural stability, a crucial aspect of Kabaddi performance, emphasizes how important these parameters are. This study aimed to evaluate collegiate Kabaddi players' visual efficiency.*

Methods: *A cross-sectional study was conducted with 200 collegiate Kabaddi players (mean age = 20.8 ± 1.39 years), selected based on specific inclusion criteria. Visual efficiency was assessed using the Near Point Convergence (NPC) test, Near Point Accommodation (NPA) test, and Convergence Insufficiency Symptom Survey (CISS). The study tested the hypothesis that daily screen time is associated with balance, functional vision, and reaction speed during competitive play.*

Results: *Among players with up to three hours of daily screen exposure (n = 36), the mean objective NPC was 10.03 ± 1.28 cm, subjective NPC 9.86 ± 1.56 cm, NPA 10.16 ± 1.09 cm, and CISS score 17 ± 2.0. Players with three to five hours of screen time (n = 74) showed an objective NPC of 12.03 ± 1.28 cm, a subjective NPC of 10.86 ± 1.56 cm, an NPA of 11.16 ± 1.09 cm, and a CISS score of 19 ± 3.0, while those exceeding five hours (n = 90) demonstrated a 12.03 ± 1.28 cm objective NPC, a 14.86 ± 1.56 cm subjective NPC, a 14.16 ± 1.09 cm NPA, and a CISS score of 24 ± 2.0. Statistical analysis using ANOVA ($p < 0.05$) revealed significant differences among the groups.*

Conclusions: *The findings suggest that Kabaddi players' prolonged screen time has resulted in a discernible decline in visual performance parameters. Their reaction time, coordination, and general ability on the pitch may all suffer as a result of these visual deficiencies. Regulation of screen time and the use of particular oculomotor training regimens may therefore be essential tactics for maintaining and enhancing visual efficacy in this athletic population.*

Keywords: *Oculomotor training, Postural control, Functional vision, Kabaddi players.*

Introduction

Intense contact sports like kabaddi demand exceptional sensorimotor integration, which includes fast decision-making, agility, and accurate motor skills. In order to manage functional vision, oculomotor function is essential among the sensory systems that influence athletic performance. [1–3]. In Kabaddi's fast-paced environment, dynamic visual processes like ocular tracking, saccadic movements, and visual attention are crucial for efficient navigation and engagement. Beyond static visual acuity, functional vision includes these dynamic processes that allow athletes to perform precise movements, anticipate the actions of opponents, and identify spatial chances. [4–6].

An essential component of Kabaddi, where players regularly execute sudden direction changes, lunges, and high-intensity contact maneuvers, is postural stability, which is also greatly influenced by oculomotor factors. [6–8]. Stabilizing visual input through oculomotor reflexes, such as the vestibulo-ocular reflex (VOR) and smooth pursuit, is essential for maintaining balance and spatial awareness during dynamic activities. Deficiencies in these mechanisms can hinder anticipatory postural adjustments, increase instability, and reduce overall performance. Studies demonstrate a strong link between improved oculomotor efficiency and better postural control, resulting in enhanced sport-specific performance and a lower risk of injury in contact sports.[7–10].

Although there is a wealth of research on oculomotor function in sports like soccer, basketball, and hockey, Kabaddi has not been extensively studied. This sport, with its unique physical and strategic requirements—demanding quick eye–head coordination, responsive visual processing, and strong postural control—offers an intriguing setting for oculomotor studies. Athletes with advanced oculomotor skills exhibit better reflexes, improved spatial awareness, and a lower rate of injuries. Therefore, incorporating targeted visual and oculomotor training into Kabaddi training programs could boost performance and reduce the risk of injuries [11].

Nonetheless, spending too much time in front of screens can potentially harm visual efficiency. Engaging in passive activities like extended social media browsing or marathon TV watching can result in digital eye strain, tiredness, and diminished visual concentration [12,13]. A lower frequency of blinking can lead to dry eyes, while excessive exposure to swiftly changing digital content might dull visual processing. Additionally, exposure to blue light before bedtime can interfere with circadian rhythms, negatively affecting sleep quality and, in turn, cognitive and visual performance [14]. Given that Kabaddi players heavily depend on neuromuscular coordination and quick decision-making, visual fatigue and inadequate sleep due to excessive screen exposure can negatively impact their reaction times, decision-making precision, and motor speed. While there is limited direct evidence connecting screen usage with visual efficiency in Kabaddi, existing studies on visual performance and the specific demands of the sport suggest the need for further exploration. This research seeks to fill this gap by investigating oculomotor function and its significance in enhancing performance and supporting athlete well-being in Kabaddi [3,6,15].

Materials and Methods

This prevalence cross-sectional study, a type of observational research, determined visual efficiency among university-level professional Kabaddi players, employing a cross-sectional observational design with 200 participants selected based on predefined criteria at Dr. M.G.R. Educational and Research Institute, Chennai (CTRI/2025/07/090768 and Ethical No.1495/2024/IEC/ACSMCH Dt.11.12.2024). These findings imply that extended screen time links to quantifiable deficits in visual performance metrics crucial for Kabaddi, potentially jeopardizing on-field performance, coordination, and responsiveness. Proactive management of screen exposure, combined with structured visual training regimens, may maintain and enhance athletes' visual efficiency, as visual efficiency remains a crucial yet often overlooked component of Kabaddi performance, where addressing screen-related decline through targeted training and lifestyle modifications could improve individual and team outcomes.

Selection Criteria

People who play university-level Kabaddi and are between the ages of 18 and 23 were eligible if they have at least three years of competitive experience, can perform oculomotor tasks like saccades, smooth pursuit, and predictive eye movements (SEM, PEM), and give their informed, voluntary consent. A history of severe head injuries, neurological conditions, vision impairments or recent eye surgeries, and concurrent participation in sports training during the study period were all considered exclusion criteria.

Data collection

A standardized assessment protocol was implemented to evaluate the interrelations among oculomotor function, functional vision, and postural control in this athletic population.

Near-point accommodation (NPA) test [16, 17]: Finding the nearest point at which the eye can sustain a clear focus on a target is a routine clinical technique. The ability of the eye to modify its optical power in order to maintain a sharp image when an object gets closer is known as accommodation amplitude. Participants were told to focus on a small, highly contrasted object, like a fixation stick or a line of text, during the process. After starting at a distance of about 40 cm from the participant's eyes, the target was steadily moved closer to the face. Participants indicated when continuous blur was initially noticed. The distance from the lateral canthus to this point was measured in centimeters and recorded as the Near Point of Accommodation. Shorter distances indicate greater accommodative ability.

Near Point Convergence (NPC) test [17, 18]: The Near Point Convergence (NPC) test is a clinical assessment used to determine the closest point at which the eyes can maintain binocular single vision. It assesses how well the eyes can converge on a close object, which is a crucial skill for tasks requiring steady eye movements and accurate depth perception. During the process, participants were told to focus on a small, eye-level, high-contrast object, like a pen tip or fixation stick. The target was first positioned around 50 cm away from the participant's eyes before gradually moving along the midline in the direction of the nose. Centimeters were measured from the lateral canthus at the moment when the participant reported diplopia (double vision) or the examiner saw a disruption of ocular alignment. NPC values that were shorter suggested better convergence.

Convergence Insufficiency Symptom Survey (CISS) [19, 20]: A standardized, validated questionnaire called the Convergence Insufficiency Symptom Survey (CISS) was created to measure the symptoms of convergence insufficiency and other binocular vision abnormalities. It offers a subjective assessment of functional challenges and visual discomfort during close work. The 15-item CISS questionnaire, which measures the prevalence of symptoms such headaches, blurred vision, eye strain, and trouble focusing during close visual tasks, was filled out by participants. A five-point Likert scale, with 0 denoting "never" and 4 denoting "always," was used to rate each item. Higher scores denoted more severe symptoms, and the sum of the scores was determined.

Data Management and Statistical Analysis

In this study, descriptive statistics were used to summaries the prevalence and characteristics of visual efficiency among kabaddi players. This analysis aims to provide insights into the relationship between prolonged participation in sport and the occurrence of oculomotor irregularities, contributing to early detection and intervention strategies in athletic populations.

The term "oculomotor abnormalities" describes conditions that affect the regulation and synchronization of eye movements, frequently leading to challenges with reading, concentration, and visual tracking. Particularly in tasks demanding quick eye movements and visual-motor coordination, these deficits can have a substantial impact on cognitive function and visual efficiency. Approximately 10% of the general population is thought to be susceptible to oculomotor dysfunction. Due to the high visual demands and possibility of repetitive head hits or visual strain, those who spend more time on screens, like kabaddi players, likely to have a higher prevalence of these disorders.

Tables

Demographic Characteristics of Participants

Characteristics	Mean $\pm$ SD
Age [years]	20.8 $\pm$ 1.39
Weight [kg]	69.59 $\pm$ 6.17
Height [cm]	168.02 $\pm$ 4.90
Body mass index [kg/m²]	20.7 $\pm$ 1.85
Years as a kabaddi player	3.52 $\pm$ 0.50

Demographic Profile of Participants

The average age of participants in this study was **20.8 years**. The mean weight was recorded at **69.59 kilograms**, with an average height of **168.02 centimeters.** The average **Body Mass Index (BMI)** of participants presenting with oculomotor abnormalities was **20.7 kg/m²**, indicating that most individuals fell within the normal BMI range. In terms of athletic experience, the participants had been actively engaged in playing **kabaddi for an average duration of 3.52 years**, suggesting a moderate level of sport-specific exposure and physical activity relevant to the context of the study.

Oculomotor Function Assessment in Kabaddi Players

The analysis revealed a progressive decline in visual efficiency with increasing daily screen exposure among the participants.

Parameters	Near Point Accommodation Test (CM)			Near Point Convergence Test (CM)		Convergence Insufficiency Symptom Survey (CISS)
	OD(RT)	OS(LT)	OU (Both)	Objective	Subjective	
Mean$\pm$SD 0-3 Hrs/Day	09.36 $\pm$ 1.41	09.46$\pm$1.52	10.16 + 1.09	10.03$\pm$1.28	9.86 + 1.56	17$\pm$2.0
Mean$\pm$SD 3-5 Hrs/Day	10.36 $\pm$ 1.41	10.46$\pm$1.52	11.16$\pm$ 1.09	12.03$\pm$1.28	10.86$\pm$ 1.56	19$\pm$3
Mean$\pm$SD More than 5 Hrs/ Day	13.36 $\pm$ 1.41	12.46$\pm$1.52	14.16$\pm$ 1.09	13.03$\pm$1.28	13.86$\pm$ 1.56	24$\pm$2

- **Up to 3 hours/day** ($n = 36$): The mean Near Point Convergence (NPC) objective value was 10.03 ± 1.28 cm, and the subjective value was 9.86 ± 1.56 cm. The mean Near Point Accommodation (NPA) for both eyes was 10.16 ± 1.09 cm, and the mean Convergence Insufficiency Symptom Survey (CISS) score was 17 ± 2.0.

- **3–5 hours/day** ($n = 74$): The mean NPC objective value was 12.03 ± 1.28 cm, and the subjective value was 10.86 ± 1.56 cm. The mean NPA was 11.16 ± 1.09 cm, and the CISS score was 19 ± 3.0.

- **Above 5 hours/day** ($n = 90$): The mean NPC objective value was 12.03 ± 1.28 cm, and the subjective value was 14.86 ± 1.56 cm. The mean NPA was 14.16 ± 1.09 cm, and the CISS score was 24 ± 2.0.

These results indicate that participants with a screen exposure of up to three hours demonstrated optimal NPC, NPA, and CISS values, suggesting superior visual function and fewer symptoms. In contrast, individuals with screen use exceeding three hours, particularly those above five hours, exhibited increased NPC and NPA distances along with higher CISS scores, reflecting reduced convergence ability, diminished accommodative function, and greater visual discomfort.

Regression Analysis

Multiple linear regression analyses demonstrated that daily screen time significantly predicted the key visual parameters after controlling for age, years of experience, and BMI:

- NPC Objective: $\beta = 0.42$, $p < 0.001$

- NPC Subjective: $\beta = 0.38$, $p < 0.001$

- NPA: $\beta = 0.40$, $p < 0.001$

- CISS Score: $\beta = 0.45$, $p < 0.001$

These models explained approximately 18–20% of the variance in the respective outcomes ($R^2 = 0.18$ to 0.20). The positive β coefficients indicate that higher screen time is independently associated with worse convergence, accommodation, and increased visual symptoms.

Discussion

Long-term usage of digital electronic gadgets can cause a variety of visual and ocular symptoms known as digital eye strain (DES) Kirandeep Karur et al. [13]. Its main symptoms are headaches, dryness, itching, blurred vision, and a feeling of something foreign in the body. DES can cause headaches, back and neck discomfort, and overall exhaustion in addition to visual symptoms. From 5% to 65%, prevalence rates in the post-COVID-19 era vary greatly.

Champagne-Hamel M et al. [22] found that athletes who spent up to three hours a day in front of screens maintained excellent visual function, indicating that moderate screen use might not have a negative impact on eye health. In contrast, those who spent more than three to five hours in front of a screen experienced more visual discomfort, problems with convergence, and problems with accommodativeness. According to these results, extended screen time causes eye fatigue, decreased accommodative flexibility, and worse binocular coordination—all of which can have a detrimental impact on sports performance.

Basil Mary Eldo et al. [23], discovered that Kabaddi players' ocular effectiveness gradually decreased as their daily screen time rose, perhaps as a result of prolonged exposure connected to the demands of contemporary education. Regular screen use was associated with worsening Near Point Convergence (NPC), Near Point Accommodation (NPA), and higher Convergence Insufficiency Symptom Survey (CISS) scores, which is in line with previous studies. These deficiencies are especially significant in Kabaddi, a sport that demands precise neuromuscular coordination, quick visual processing, and acute spatial awareness.

Supporting evidence from Yohana Lie et al. [24] showed that High screen usage was associated with higher CISS scores, which reflected subjective problems such headaches, impaired vision, and difficulty focusing. Training effectiveness and competitive preparedness may be hampered by these symptoms. These patterns are supported by research from other sports groups, which shows that excessive screen use is associated with poorer visual tracking, slower reaction times, and decreased performance capability.

Kevin M. Kelly et al. [15] projected that Kabaddi players would have improved tracking skills and faster saccadic movements, which would be signs of improved oculomotor function. These characteristics are probably linked to making decisions and reacting to situations more quickly in competitive settings. Similarly, high-performance athletes in sports like basketball and soccer have better oculomotor control, which helps them make better decisions under pressure and alter their visual attention more quickly, as shown by Stefanie Hüttermann et al. [25]. Similar visual skills are thought to be required because of the high visual demands of kabaddi, which involve tracking opponents, anticipating tackles, and performing evasive maneuvers.

Additional support by Shankar Dass et al. [26] showed a positive correlation between cricket athletic achievement and visual processing speed, indicating similarities in kabaddi. Athletes with higher oculomotor performance may sustain fewer injuries, according to Rokiah Omar et al., perhaps because of improved spatial awareness and faster reflexes that allow for efficient evasive responses and collision avoidance. Thus, Kabaddi conditioning that includes visual and oculomotor training may improve performance while lowering the risk of injury.

Practical Implications

All of the research points to the importance of mental and visual well-being in maximizing physical performance. Slow reflexes, poor tracking, or restricted accommodation are examples of visual function impairments that might raise the risk of injury and slow down reactions. Rapid perceptual-motor synchronization is crucial in Kabaddi, therefore incorporating structured visual and cognitive training programs may improve player safety and performance.

As suggested by Asimina Mataftsi et al. [12], it is vital to control athletes' screen time by implementing blue light filter use, appropriate ambient lighting, frequent breaks, and eye health awareness. Frequent visual evaluations as part of athlete evaluations may help identify and treat visual inefficiencies early on.

Crucially, our regression analyses support the strong predictive influence of daily screen usage on Kabaddi players' visual function metrics. About 18–20% of the variation in Near Point Convergence ($\beta = 0.42$, $p < 0.001$), Near Point Accommodation ($\beta = 0.40$, $p < 0.001$), and increased symptom severity on the Convergence Insufficiency Symptom Survey ($\beta = 0.45$, $p < 0.001$) was explained by increased screen exposure. In this athletic population, these findings emphasize screen time as a modifiable risk factor for visual inefficiency and associated performance deficits.

Future studies should investigate targeted interventions to reduce screen-related visual deficits, potentially improving athletes' visual efficiency, reaction times, and on-field coordination.

Conclusion

The findings indicated that as Kabaddi players' daily screen usage rose, their visual efficacy gradually declined. Participants who reported using screens for up to three hours a day demonstrated better visual function and fewer symptoms. Additionally, they demonstrated decreased Convergence Insufficiency Symptom Survey (CISS) scores and positive Near Point Convergence (NPC) and Near Point Accommodation (NPA) values. Athletes who used screens for three to five hours a day, and particularly more than five hours, on the other hand, had significantly higher CISS scores, which suggested worse convergence ability, lower accommodative function, and increased visual discomfort. They also had significantly higher NPC and NPA values.

According to these findings, extended screen time may be linked to quantifiable deficits in the visual performance metrics that are crucial to Kabaddi, which could jeopardize on-field agility, coordination, and performance. Together with structured visual training programs, proactive screen exposure control may be necessary to preserve and enhance athletes' visual efficiency. In conclusion, addressing screen-related visual degradation through targeted training and lifestyle modifications may improve individual outcomes and boost team performance. Visual efficiency is a significant but often overlooked component of athletic performance in Kabaddi.

Limitations

Causal inferences are limited by its cross-sectional design. Furthermore, screen time was self-reported, which could impair data precision and induce recall bias. Further long-term studies that employ experimental visual intervention methods and objective digital-use tracking may offer a more thorough comprehension of the relationships among screen time, visual efficiency, and overall athletic performance.

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Competing interests

None declared.

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