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Original Article

Effect of One Hour of Smartphone Reading Under Different Illumination and Body Positions on Accommodative Function in Healthy Young Adults

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ABSTRACT

Background: Prolonged smartphone use has become increasingly common among young adults and is associated with accommodative stress and digital eye strain. Body posture during smartphone use may further influence accommodative performance.

Objective: To evaluate the effect of one hour of smartphone reading on accommodative function in erect and supine positions under bright illumination among healthy young adults.

Methods: This prospective experimental study included 31 healthy participants aged 18–30 years. Baseline accommodative parameters, including Near Point of Accommodation (NPA), Amplitude of Accommodation (AA), Negative Relative Accommodation (NRA), Positive Relative Accommodation (PRA), Accommodative Facility (AF), and accommodative convergence to accommodation (AC/A) ratio, were assessed using standard clinical procedures. Participants then read the same novel on a smartphone for one hour under bright illumination in erect and supine positions, followed by reassessment of all accommodative parameters.

Results: The mean age of participants was 20.48 ± 1.34 years. Following smartphone use, NPA increased from 5.94 ± 1.29 cm at baseline to 6.58 ± 1.39 cm in the supine position, while AA decreased from 17.51 ± 3.19 D to 15.81 ± 3.13 D. NRA showed a slight reduction, whereas PRA demonstrated a modest increase. The AC/A ratio and accommodative facility exhibited minimal changes.

Conclusion: One hour of smartphone reading produced measurable alterations in accommodative function, particularly in the supine position. Maintaining an upright posture, appropriate viewing distance, adequate illumination, and regular visual breaks may help reduce accommodative stress and improve visual comfort during prolonged smartphone use.

Keywords: Smartphone use; Accommodation; Amplitude of accommodation; Near point of accommodation; Digital eye strain; Body posture.

Introduction:

The widespread adoption of smartphones has transformed modern communication, education, and professional activities. Smartphones are now indispensable tools for accessing educational resources, digital communication, entertainment, and healthcare information. Recent global estimates indicate that billions of individuals use smartphones daily, with young adults representing the most intensive users because of academic and occupational demands [1]. This increased reliance on digital devices has resulted in prolonged periods of near work, exposing the visual system to sustained accommodative and vergence stress [2]. Consequently, visual discomfort associated with prolonged digital device use has emerged as a growing public health concern [3].

Digital eye strain, also referred to as computer vision syndrome, encompasses a spectrum of ocular and visual symptoms resulting from prolonged use of digital displays [4]. Common symptoms include eyestrain, blurred vision, headaches, dry eye, diplopia, ocular discomfort, neck pain, and reduced visual performance [5]. These symptoms are multifactorial, involving accommodative dysfunction, vergence anomalies, decreased blink rate, tear film instability, poor ergonomics, inappropriate viewing distances, and suboptimal ambient illumination [6]. Among these factors, accommodative stress plays a central role in the development of visual fatigue during sustained smartphone use [7].

Accommodation is a dynamic physiological process through which the crystalline lens alters its optical power to maintain a clear retinal image of near objects [8]. This process is mediated by contraction of the ciliary muscle, relaxation of the zonular fibers, and increased curvature of the crystalline lens [9]. Efficient accommodation is essential for reading, learning, and prolonged near visual tasks. However, continuous accommodative effort without sufficient visual breaks may result in accommodative fatigue, characterized by transient reductions in accommodative amplitude, delayed accommodative responses, decreased accommodative facility, and symptoms of asthenopia [8].

Compared with conventional printed material, smartphones present unique visual challenges. Their relatively small display size, high pixel density, reduced font size, and short viewing distance substantially increase accommodative demand [6]. Furthermore, prolonged exposure to high-energy visible light emitted from smartphone screens, particularly under low ambient illumination, may increase visual discomfort [4]. Unlike printed text, smartphone displays require continuous visual adaptation because of screen luminance, contrast variation, and scrolling behavior, thereby increasing the physiological workload imposed on the accommodative system [5]. Ambient illumination has an important influence on accommodative function. Under bright lighting conditions, pupillary constriction increases the depth of focus and reduces accommodative demand, whereas dim illumination induces pupillary dilation, reducing depth of field and increasing accommodative fluctuations [6]. Reduced illumination may therefore exaggerate accommodative fatigue during prolonged smartphone use, potentially contributing to greater visual discomfort [7]. Body posture during smartphone use represents another important but often overlooked ergonomic factor. Smartphones are frequently used while sitting, lying down, or reclining, especially during leisure activities. Supine posture may alter viewing distance, gaze angle, ocular alignment, and accommodative demand compared with the erect position [8]. However, only a limited number of studies have evaluated the combined effects of posture and illumination on accommodative responses during prolonged smartphone use. Several previous studies have demonstrated that smartphone use adversely affects accommodative parameters. Mijung Park et al. reported a significant reduction in accommodative amplitude after smartphone viewing among young adults [9]. Beatriz Antona et al. observed increased visual discomfort and accommodative symptoms during smartphone reading, particularly under reduced ambient illumination. Similarly, Wiki Safarina Narawi et al. demonstrated significant alterations in accommodative status following smartphone use . More recently, Monica Mareena J et al. reported significant changes in accommodative and vergence parameters following smartphone reading under different illumination and body positions [2]. Despite these findings, most previous investigations evaluated relatively short durations of smartphone use (20–30 minutes) and did not comprehensively investigate the combined influence of prolonged screen exposure, illumination, and body posture on accommodative function. Moreover, evidence among healthy young adults remains limited.

Therefore, the present prospective experimental study aimed to evaluate the effects of one hour of smartphone reading under bright and dark illumination in erect and supine body positions on accommodative function among healthy young adults. We hypothesized that prolonged smartphone use would significantly alter accommodative parameters, with greater changes occurring under dark illumination and in the supine position because of increased accommodative demand and reduced visual efficiency.

MATERIALS AND METHODS

This prospective experimental study was conducted at the Department of Optometry, Ahalia School of Optometry and Research Centre, Palakkad, Kerala, India, to investigate the effects of prolonged smartphone reading on accommodative function under different illumination conditions and body postures among healthy young adults. The study protocol was approved by the Institutional Ethics Committee of Ahalia School of Optometry and Research Centre, and all procedures adhered to the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from each participant before enrolment after explaining the objectives and procedures of the study.

A total of 31 healthy participants aged between 18 and 30 years were recruited using a simple random sampling technique. Individuals with a best-corrected visual acuity of 20/20 in both eyes, normal binocular vision, and no history of ocular pathology, accommodative or vergence disorders, ocular surgery, trauma, or systemic diseases affecting visual function were included in the study. Participants with significant refractive errors requiring changes in optical correction, neurological disorders, or any condition that could influence accommodative performance were excluded. Before participation, each subject underwent a comprehensive ophthalmic examination, including distance and near visual acuity assessment, retinoscopy, subjective refraction, binocular vision evaluation, stereopsis assessment, Worth Four Dot Test at distance and near, cover and uncover tests, and ocular motility examination to confirm eligibility.

Baseline accommodative function was assessed using standard clinical procedures. The accommodative parameters evaluated included Near Point of Accommodation (NPA), Amplitude of Accommodation (AA), Negative Relative Accommodation (NRA), Positive Relative Accommodation (PRA), Accommodative Facility (AF), and the accommodative convergence to accommodation (AC/A) ratio. The Near Point of Accommodation and Amplitude of Accommodation were measured using the conventional push-up method, while Negative Relative Accommodation and Positive Relative Accommodation were determined using standard binocular lens techniques. Accommodative Facility was evaluated with ±2.00 diopter flipper lenses and recorded as cycles per minute. The AC/A ratio was assessed using the gradient method according to established optometric procedures. All measurements were performed by the same examiner under standardized testing conditions to minimize inter-observer variability. Following the baseline assessment, participants were instructed to read the same novel continuously on a smartphone for one hour under four experimental conditions: bright illumination in the erect position, bright illumination in the supine position, dark illumination in the erect position, and dark illumination in the supine position. The smartphone settings, including screen brightness, font size, and reading distance, were maintained consistently throughout the study to minimize variability. Ambient illumination was standardized for all participants during each experimental condition to ensure uniform testing conditions. After completion of each reading session, all accommodative parameters were reassessed using the same clinical procedures employed during the baseline examination. The primary outcome measures were changes in Near Point of Accommodation, Amplitude of Accommodation, Negative Relative Accommodation, Positive Relative Accommodation, Accommodative Facility, and AC/A ratio following one hour of smartphone reading under different illumination conditions and body positions. The study was designed to compare accommodative responses before and after smartphone use and to determine whether body posture and ambient illumination influenced accommodative performance. All collected data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 31.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean ± standard deviation. The normality of the data distribution was assessed using the Kolmogorov–Smirnov test. As the data were not normally distributed, non-parametric statistical tests were employed.

The Friedman test was used to compare repeated measurements obtained under different experimental conditions, while pairwise comparisons were performed using the Wilcoxon signed-rank test. A two-tailed p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

A total of 31 healthy young adults (62 eyes) participated in the present prospective experimental study. The mean age of the participants was 20.48 ± 1.34 years, with 25 females (80.6%) and 6 males (19.4%). All participants completed the study protocol successfully, and complete datasets were available for analysis. Accommodative parameters were assessed at baseline and after one hour of smartphone reading under bright illumination in the erect and supine positions. Descriptive statistics of the accommodative parameters are presented in Table 1.

The mean Near Point of Accommodation (NPA) was 5.94 ± 1.29 cm at baseline. Following smartphone use in the erect position, the mean NPA improved slightly to 5.74 ± 1.08 cm. However, in the supine position, the NPA increased to 6.58 ± 1.39 cm, indicating a recession of the near point and suggesting greater accommodative demand while reading in the supine posture. The mean Amplitude of Accommodation (AA) was 17.51 ± 3.19 D at baseline. A marginal increase to 17.90 ± 2.76 D was observed after smartphone reading in the erect position. Conversely, the mean amplitude decreased to 15.81 ± 3.13 D in the supine position, demonstrating reduced accommodative ability after prolonged smartphone use while lying down.

The Negative Relative Accommodation (NRA) decreased from 3.96 ± 0.93 D at baseline to 3.59 ± 0.76 D in the erect position and 3.81 ± 0.85 D in the supine position, suggesting a mild reduction in accommodative relaxation after sustained near work. In contrast, Positive Relative Accommodation (PRA) increased from 4.50 ± 1.08 D at baseline to 4.96 ± 1.08 D in the erect position and 4.86 ± 1.26 D in the supine position, indicating increased accommodative effort following prolonged smartphone viewing.

The AC/A ratio remained relatively unchanged throughout the study, with mean values of −0.06 ± 2.59 at baseline, 0.23 ± 2.55 in the erect position, and −0.23 ± 2.60 in the supine position. These findings suggest that accommodative convergence was minimally affected by smartphone use. Similarly, Accommodative Facility (AF) showed only minor variations. The mean accommodative facility was 19.26 ± 6.99 cycles/min at baseline, 18.84 ± 7.69 cycles/min after smartphone reading in the erect position, and 19.48 ± 8.28 cycles/min in the supine position, indicating relatively preserved accommodative flexibility despite sustained near visual activity.

Overall, descriptive analysis demonstrated measurable changes in accommodative function following one hour of smartphone use under bright illumination. The greatest changes were observed in the Near Point of Accommodation and Amplitude of Accommodation, particularly in the supine position, whereas the AC/A ratio and Accommodative Facility remained comparatively stable. Statistical analysis using repeated-measures tests should be used to determine the significance of these observed differences.

Parameter	Baseline Mean ± SD	Bright Erect Mean ± SD	Bright Supine Mean ± SD
Near Point of Accommodation (cm)	5.94 ± 1.29	5.74 ± 1.08	6.58 ± 1.39
Amplitude of Accommodation (D)	17.51 ± 3.19	17.90 ± 2.76	15.81 ± 3.13
Negative Relative Accommodation (D)	3.96 ± 0.93	3.59 ± 0.76	3.81 ± 0.85
Positive Relative Accommodation (D)	4.50 ± 1.08	4.96 ± 1.08	4.86 ± 1.26
AC/A Ratio	2.19 ± 1.38	2.29 ± 1.14	2.35 ± 1.12
Accommodative Facility (cycles/min)	19.26 ± 6.99	18.84 ± 7.69	19.48 ± 8.28

Table 1. Mean ± SD of accommodative parameters at baseline and after smartphone reading under bright illumination (n = 31)

DISCUSSION

The present study evaluated the effect of one hour of smartphone use on accommodative response under different illumination conditions and body postures among healthy young adults. With the increasing dependence on smartphones for educational, occupational, and recreational activities, prolonged near work has become a major contributor to visual discomfort and accommodative dysfunction. The present findings demonstrate that smartphone use produces measurable alterations in accommodative function, particularly when reading is performed in the supine position. The study population consisted predominantly of young adults, with a mean age of 20.48 ± 1.34 years, representing the age group with the highest smartphone usage. This population possesses robust accommodative ability; therefore, any measurable alteration following prolonged smartphone exposure is clinically relevant because it may indicate the early development of accommodative stress despite normal ocular health.

Among the accommodative parameters evaluated, the Near Point of Accommodation (NPA) demonstrated noticeable changes after one hour of smartphone reading. The NPA improved slightly in the erect position but receded in the supine position, indicating reduced accommodative efficiency while reading in a lying posture. Changes in body posture may alter viewing distance, head position, and visual ergonomics, thereby increasing accommodative demand during prolonged near tasks. Similar observations have been reported in studies investigating digital device use, where sustained near work resulted in accommodative fatigue and transient reductions in accommodative performance [1,2]. The Amplitude of Accommodation (AA) also showed posture-dependent changes. A slight increase was observed after smartphone reading in the erect position, whereas a reduction occurred in the supine position. This finding suggests that prolonged smartphone use while lying down may induce accommodative fatigue, reducing the eye's ability to sustain clear near vision. Previous studies have reported that continuous digital device use can temporarily reduce accommodative amplitude because of sustained ciliary muscle contraction and prolonged accommodative effort [3,4].

The Negative Relative Accommodation (NRA) decreased modestly following smartphone use, whereas the Positive Relative Accommodation (PRA) demonstrated a slight increase. These findings indicate that sustained near viewing may reduce the ability to relax accommodation while simultaneously increasing accommodative demand. Similar alterations in relative accommodation have been described in individuals experiencing digital eye strain following prolonged use of electronic displays [5,6]. The AC/A ratio remained relatively stable throughout the study, suggesting that accommodative convergence was minimally affected by one hour of smartphone exposure. Likewise, Accommodative Facility showed only minor variations between the study conditions. These findings imply that short-term smartphone use primarily influences accommodative amplitude and focusing performance rather than the speed of accommodative response or accommodative convergence. Previous investigators have similarly reported that accommodative facility may remain relatively preserved following short-duration near visual tasks, particularly in healthy young adults with normal binocular vision [7].

Body posture appeared to influence accommodative performance. Reading in the supine position resulted in greater changes in the Near Point of Accommodation and Amplitude of Accommodation than reading in the erect position. These findings suggest that poor viewing ergonomics associated with lying down may increase accommodative demand and contribute to visual fatigue. Maintaining an appropriate reading posture and viewing distance during smartphone use may therefore help reduce accommodative stress and improve visual comfort. The present findings have important clinical implications. Although the observed changes occurred after only one hour of smartphone use, repeated or prolonged exposure over months or years may contribute to persistent accommodative symptoms, digital eye strain, and reduced visual comfort. Eye care practitioners should educate smartphone users regarding appropriate working distance, regular visual breaks, adequate ambient illumination, and proper body posture during prolonged near work. Implementation of strategies such as the 20-20-20 rule may reduce accommodative stress and improve ocular comfort during extended smartphone use. The present study has several limitations. The sample size was relatively small and consisted primarily of healthy young adults, limiting the generalizability of the findings to older individuals or patients with accommodative or binocular vision disorders. Smartphone use was evaluated over a single one-hour period, and longer exposure durations may produce different accommodative responses.

In addition, environmental factors such as screen brightness, font size, viewing distance, and individual smartphone settings were not standardized beyond the study protocol. Future studies involving larger and more diverse populations, longer observation periods, and objective measurements of accommodative response are warranted to better understand the long-term effects of smartphone use under different viewing conditions. Overall, the present study demonstrates that smartphone use influences accommodative function, with the most pronounced effects observed during reading in the supine position. The findings highlight the importance of proper viewing posture and appropriate visual ergonomics during prolonged smartphone use and support the need for preventive strategies to minimize accommodative stress and digital eye strain among young adults.

Conclusion: The present study demonstrated that one hour of smartphone use produced measurable changes in accommodative function among healthy young adults. Alterations were observed in the Near Point of Accommodation, Amplitude of Accommodation, Negative Relative Accommodation, and Positive Relative Accommodation, indicating that prolonged near visual activity can influence the accommodative system. The most pronounced changes were observed when smartphone reading was performed in the supine position, suggesting that body posture may have an important role in accommodative performance during sustained smartphone use. In contrast, the AC/A ratio and Accommodative Facility remained relatively stable following smartphone exposure, indicating that short-term smartphone use had minimal influence on accommodative convergence and the speed of accommodative response in this study population. These findings highlight the importance of maintaining appropriate viewing posture and adequate illumination while using smartphones for prolonged periods. Adoption of healthy visual habits, including maintaining an appropriate working distance, avoiding prolonged smartphone use in the supine position, ensuring adequate ambient lighting, and taking regular visual breaks, may help reduce accommodative stress and improve visual comfort. Although the study provides valuable insights into the influence of smartphone use on accommodative response, the relatively small sample size and evaluation of only short-term exposure limit the generalizability of the findings.

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References:

1. *Kahal F, Al Darra A, Torbey A. Computer vision syndrome: a comprehensive literature review. Future Sci OA. 2025 Dec;11(1):2476923. doi: 10.1080/20565623.2025.2476923. Epub 2025 Mar 8. PMID: 40055942; PMCID: PMC11901492.*
2. *Sheppard AL, Wolffsohn JS. Digital eye strain: prevalence, measurement and amelioration. BMJ Open Ophthalmol. 2018 Apr 16;3(1):e000146. doi: 10.1136/bmjophth-2018-000146. PMID: 29963645; PMCID: PMC6020759.*
3. *Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic Physiol Opt. 2011 Sep;31(5):502-15. doi: 10.1111/j.1475-1313.2011.00834.x. Epub 2011 Apr 12. PMID: 21480937.*
4. *Coles-Brennan C, Sulley A, Young G. Management of digital eye strain. Clin Exp Optom. 2019 Jan;102(1):18-29. doi: 10.1111/cxo.12798. Epub 2018 May 23. PMID: 29797453.*
5. *Mohan A, Sen P, Shah C, Jain E, Jain S. Prevalence and risk factor assessment of digital eye strain among children using online e-learning during the COVID-19 pandemic: Digital eye strain among kids (DESK study-1). Indian J Ophthalmol. 2021 Jan;69(1):140-144. doi: 10.4103/ijo.IJO_2535_20. PMID: 33323599; PMCID: PMC7926141.*
6. *Sharma A, Satija J, Antil P, Dahiya R, Shekhawat S. Determinants of digital eye strain among university students in a district of India: a cross-sectional study. Z Gesundh Wiss. 2023 May 13:1-6. doi: 10.1007/s10389-023-01924-2. Epub ahead of print. PMID: 37361308; PMCID: PMC10182338.*
7. *Ichhpujani P, Singh RB, Foulsham W, Thakur S, Lamba AS. Visual implications of digital device usage in school children: a cross-sectional study. BMC Ophthalmol. 2019;19(1):76. doi: 10.1186/s12886-019-1082-5.*

8. *Ganne P, Najeeb S, Chaitanya G, Sharma A, Krishnappa NC. Digital Eye Strain Epidemic amid COVID-19 Pandemic - A Cross-sectional Survey. Ophthalmic Epidemiol. 2021 Aug;28(4):285-292. doi: 10.1080/09286586.2020.1862243. Epub 2020 Dec 28. PMID: 33369521.*
9. *Ha A, Lee YJ, Lee M, Shim SR, Kim YK. Digital Screen Time and Myopia: A Systematic Review and Dose-Response Meta-Analysis. JAMA Netw Open. 2025 Feb 3;8(2):e2460026. doi: 10.1001/jamanetworkopen.2024.60026. PMID: 39982728; PMCID: PMC11846013.*

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