ORIGINAL ARTICLE

The Effect of Near Work on The Onset and Severity of Convergence Insufficiency in Individuals Aged Between 8 Years to 35 Years

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Abstract:

Purpose: To evaluate the effect of near work on the onset and severity of convergence insufficiency in individuals aged between 8 years to 35 years

Methodology: A prospective cross-sectional study was conducted on 150 participants aged between 8-35 years undertaking ≥2 hours/day of near work were enrolled using a convenient, non-probability sampling technique from March 2025 to June 2025 from the Outpatient Department, Khairun-Nisa Eye Hospital, Karachi, Pakistan. Convergence insufficiency was evaluated using Near Point of Convergence (NPC) measurement and the Convergence Insufficiency Symptom Survey (CISS). Chi-Square test was applied to analyze the data in SPSS version 27, with p-value < 0.05 considered statistically significant.

Results: Out of the 150 respondents, the CI group recorded a lower mean age (23 years) than the non-CI group (25.6 years) (p = 0.007). Gender distribution was even (48.7% female and 51.3% male) and did not significantly correlate with CI (p = 0.8). In both groups, the median NPC had the same value (13 cm) with a P-value of 0.4. According to CISS requirements, 82.7% of the respondents were symptomatic for CI. CI group reported a median of 6 hours/day near work time and those in the non-CI group reported 4 hours/day (p < 0.001).

Conclusion: Symptomatic CI was highly prevalent (82.7%) in persons aged 8-35 years and closely related to long-term near work. While the NPC measurement of both groups was not significantly different. These findings underscore the need to conduct regular binocular vision screening in populations at risk. *Al-Shifa Journal of Ophthalmology 2026; 22(3): 130-136.*

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Introduction:

In this age of advancing technology excessive use of smart devices and gadgets in children and adults are raising many concerns and impacting their eye health, along with this, individuals who perform tasks that require constant near vision, such as reading books for extended periods, people engaged in office work, or watchmakers doing precise work, also face numerous challenges. Whether a person is using a laptop computer or a mobile smart device or doing constant near work the visual symptoms linked to them have been found to be identical[1,2]. Concerns regarding students' visual health are raised by the growing use of e-learning in educational

systems. The burden of screen time is associated with increased risk of developing convergence insufficiency and digital eye strain in people[3]. Convergence and accommodation are especially important since electronic gadgets are used at close working distances[3]. The miosis is additionally impacted by the spectral distribution of light, which causes convergence issues when reading[4]. Convergence is a tendency to look at a close object by turning both eyes inward toward one another. The ability to move both eyes outward to gaze at a far-off object is known as divergence, which is the reverse of convergence[5]. The normal NPC is about 6-10 centimeters. If the NPC is more than 10 centimeters, this is a sign of poor convergence other clinical manifestations are exophoria (XOP) that is greater in near than the distance by 4 PD (Prism diopters) or more, reduced positive fusional vergence (PFV) (Base out reserves) and reduced negative relative accommodation (NRA)[6]. Convergence insufficiency reduces how your eyes converge when you look at objects close by[7].The symptoms of convergence insufficiency are headache, eye strain, Blurry vision, Squinting, closing or rubbing an eye, dizziness diplopia, motion sickness, and loss of concentration during a task performance[8]. Causes of convergence insufficiency is prolong near work, stress, neuro degenerative conditions also family history. The prevalence range of convergence insufficiency varies from 1.7% to 33%, depending on the study[9,10]. Users of visual display terminals and the professions where individuals are required to work at a constant near distance frequently experience a prevalence rate of visual diseases and indications of ocular fatigue, and the function of an optometrist is farther in raising awareness of these elements[11]. According to a systematic review by Mohamed and Alrasheed (2023), roughly 7.98% of people suffer from convergence insufficiency. f the treatment studies, 80% preferred vision therapy, and 42% said that the most successful approach was office-based vergence/accommodative therapy combined with home reinforcement[12]. Pillay and Munsamy (2021) conducted a thorough study and discovered that the prevalence of CI varied between 3.5% and 18% in clinical trials and between 5.46% and 13% in non-clinical settings. According to diagnostic criteria, the prevalence of CI in primary school students ranged from 6.80% to 31.40%, while in high school students, it might reach 32.60%. According to the review, there is no clear correlation between CI and the use of e-devices, even if screen time has been associated to myopia[3]. The frequency of CI among the elderly population was investigated in 2021. According to the study, 21.5% of subjects had three-sign CI and 29.6% had two-sign CI. It's interesting to note that there was no discernible trend in prevalence with age or a significant difference between men and women[13]. Among patients aged 15–35, Saeed et al. (2020) reported a 38.4% prevalence of accommodative insufficiency and a 29.4% prevalence of CI. Blurred vision, headaches, and eye strain were common symptoms[14]. The prevalence and effects of accommodative insufficiency (AI) and convergence insufficiency (CI) was evaluated in a 2019 study. According to the study, 2% of children had definite CI; when clinically important instances are taken into account, the frequency rises to 6.8%. 10% of the children had AI, and 3% had both CI and AI at the same time[10]. According to a 2017 study, 12.4% of participants had CI, and 55% said they were visually uncomfortable. These results imply that university professors are likely to have both CI and visual discomfort[15]. With increasing digital screen time and academic demands,

prolonged near work places significant strain on binocular vision. Investigating this relationship is essential to establish effect of prolonged near work on the onset and severity of Convergence Insufficiency.

Methodology:

A prospective cross-sectional design was conducted at Khairu-Nisa Eye Hospital in Karachi, Pakistan, from March 2025 to June 2025. Data was collected through a convenient, non-probability sampling technique after the approval, KNNEH/ERC/APR/10-25. The NCSS PASS was used to determine the sample size which was found out to be 150 with an 80% power and a 5% margin of error. Patients who were willing to participate and met the inclusion criteria were chosen from among those who attended the hospital's outpatient department. People of age between 8 and 35 years who study, read, or use digital devices like computers or smartphones for at least two hours per day were eligible to take part in this study and gave their informed consent for participation and publishing. To avoid any confounding effects on visual function assessments, participants with a diagnosis of neurological or ocular conditions with the exception of convergence insufficiency (CI) were not allowed to participate in this study. A thorough history-taking procedure was the first step in the evaluation, which focused on symptoms like headaches, eye strain, blurred or double vision, and trouble focusing when performing close activities. Convergence insufficiency was measured by two factors. Poor convergence and maybe convergence insufficiency was indicated by an NPC break point larger than 10 cm. The Convergence Insufficiency Symptom Survey (CISS), a validated 15-item questionnaire, was used to measure the severity of symptoms. When used to evaluate CI symptoms in a range of age groups, the CISS has shown strong construct validity and reliability. IBM SPSS Statistics software, version 27, was used to analyze the data. The prevalence of convergence insufficiency (CI) symptoms and participant data, such as age, gender, and length of daily near labor, was compiled using descriptive statistics. Chi-square tests was used to evaluate relationship between categorical variables like near work length categories and presence of CI symptom.

Results:

This study involved 150 participants, the mean age of the participants in their group of convergence insufficiency (CI) was 23 years (18 years to 27 years) compared to the mean age of the comparison (non-CI) group that was 25.59 years (23 years to 29 years) with a significant difference. The outcome shows that the age distribution in the two groups differed in a significant way ($p = 0.007$) whereby the younger participants were likely to have more CI. The distribution of the sample in terms of gender allocation indicates insignificant results between the CI and non-CI groups ($p = 0.8$). The Near Point of Convergence (NPC), had to be evaluated during the diagnosis of CI in both groups. CI and non-CI groups had a median NPC of 13 cm. The interquartile ranges of the CI group were 12 to 13.5 cm and non-CI was 12.5 and 14 cm. Variation in NPC was not so important ($p = 0.4$). Although NPC values exceeded the normal cut-off point of 10 cm, the two groups had similar means of convergence ranges which could mean NPC sufferers cannot be efficient enough to indicate severity or preponderance of the symptoms.

Table 1: Demographic and Clinical Profile of Study Participants

Age (Years)	23.00 (18.00 – 27.00)
Age Categories, n (%)	
Children (7–12 years)	18 (12.0%)
Adolescents (13–18 years)	17 (11.3%)
Early Young Adults (19–24 years)	41 (27.3%)
Late Young Adults (25–30 years)	52 (34.7%)
Mature Adults (31–36 years)	22 (14.7%)
Gender Distribution, n (%)	
Female	73 (48.7%)
Male	77 (51.3%)
CISS Symptom Status, n (%)	
CI Symptomatic (CI Group)	124 (82.7%)
Asymptomatic / Non-CI Group	26 (17.3%)

This was the most striking result as there was a big disparity in the amount of near work per day between the two groups. The group of CI subjects had a median of 6 (IQR 5-7) hours per day of near work and the non-CI membership had 4 (IQR 3-5) per day. This variation was of statistical significance ($p < 0.001$). It is interesting to note that these findings show that there is a close relationship between protracted near work activity and the presence of convergence insufficiency, supporting the theory that the use of digital devices and associated extended near optical work add to a personal development or increment in convergence insufficiency.

Table 2: Comparison Between CI and Non-CI Groups

Parameters	CI Group (n = 124)	Non-CI Group (n = 26)	p-value
Age (Years), Mean (Range)	23.00 (18 – 27)	25.59 (23 – 29)	0.007
Gender Distribution, n (%)			
Female (n = 73)	60 (48.4%)	13 (50%)	0.800
Male (n = 77)	64 (51.6%)	13 (50%)	
Near Point of Convergence (NPC) (cm)	13.0 (12.0 – 13.5)	13.0 (12.5 – 14.0)	0.400
Daily Near Work Duration (Hours/Day)	6.0 (5.0 – 7.0)	4.0 (3.0 – 5.0)	< 0.001

Discussion:

The study tested the hypothesis of association between prolonged near work and convergence insufficiency (CI) in patients between the age of 8 and 35 years. The research has identified CI symptoms using the Convergence Insufficiency Symptom Survey (CISS) incidence of 82.7%, which significantly contrasts the entire division of the non-clinical population of Spanish children aged 6 to 14 years (5.30%) studied by Sánchez-Cano et al., 2022[17]. There was a large age variation among the groups: average age of CI group was 23 years, and convergence sufficient group was 25.6 years old ($p = 0.007$). This corresponds with the study conducted by Usgaonkar et al., 2021 on post-pandemic data according to which the prevalence of symptomatic CI was above among the younger demographics performing intensive screen-based near work[18].

The duration of near-work per day was also much longer in CI group (median 6 hours) than in the sufficiency group (4 hours, $p < 0.001$), which also leads to the significance

of excessive use of digital devices in developing CI. Similar effects on higher mean CISS scores, and more significant binocular vision anomalies were also seen in prior study of children conducted by Cai et al., 2024 with screen-time 4 hours/day or more, compared to less than 4 hours/day in children with no significant difference in age and mean distance diopter prescriptions in that study group[19].

The Near Point of Convergence (NPC) was not significantly different among the groups ($p = 0.4$) though both groups had a median value of ~13 cm. This observation reminds us that clinical measurements, in some cases as studied by Borsting et al., 2003, do not correlate well with symptom burden and that when testing CI, it is possible to under-diagnose the condition in the absence of validated symptom questionnaires such as the CISS[20].

The total CI prevalence was not different by gender ($p = 0.8$) as per available previous epidemiological study by Barrett et al., 2009 with reported prevalence ranging between 4 and 6% in children of both genders[21]. There possibly are small gender variations in the reporting of the symptoms that do not appear to manifest actual clinical difference.

The high prevalence of this study might also indicate the overall epidemiology of the non-strabismic binocular vision disorders (NSBVD), in which the CI is most frequent, with the prevalence of approximately 18-30% in the population with a high near demand in the study by Lara et al., 2001[22].

A systematic review and meta-analysis conducted by Mohamed et.al 2023, estimated CI prevalence in the pool of ~7.98 % worldwide, supporting the previous results and emphasizing a significant heterogeneity due to differences in diagnostic criteria, demographic groups, and the methodology[23].

The cross-sectional study design of this study inhibits any chance of determining a cause-effect relationship between long-time near work activities and convergence insufficiency (CI). Sampling of one hospital is a convenience design that makes it less generalizable. The largest group of participants was between 18 and 27 which under-represented lower age groups. There can be bias in symptom severity self-reporting through CISS. Such main clinical parameters
as fusional vergence and phoria were not evaluated. Extra-physical (screen distance, lighting, mental fatigue) were uncontrolled. Besides, the kind of digital device to be applied was not mentioned, which could alter the variation of symptoms. The limitations prove how important it would be to conduct a more general study that would be able to recap the character of the research.

Conclusion:

The findings showed a very high prevalence rate of symptomatic CI (82.7%), which is much higher than estimated in the general population prior to this study. This underscores the developing issue of younger people and digital device use and enhanced visual needs, especially in the post-pandemic world offering greater quantities of screen-based tasks than ever before. This proves the fact that high exposure to near activities, e.g., reading, or screen time, is a major contributor to the onset of CI.

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