

Original Research Article

Interconnection between pre-presbyopia, asthenopia and refractive errors among handcrafting workers

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ABSTRACT

Background: The aim and objectives of the study were to determine the effect of hand-crafting on different types of refractive errors and to verify whether there is an interconnection between asthenopia and pre presbyopia with such kind of work, and also to evaluate the effect of hand-crafting on pre-presbyopia, asthenopia and refractive errors.

Methods: This is a cross sectional study and for this study, 4800 subjects aged 16-35 years were selected. Visual acuity, retinoscopy, flashlight examination, ophthalmoscopy, and pencil push-up test were performed on each subject. A questionnaire was also completed with the information given by the subjects after informed consent.

Results: For this study, a total of 4800 patients, 35% were males and 65% females, aged 16 to 35 years were selected to check for eye strain, headache, decrease in near vision before the age of 35 years, and whether or not any type of refractive error was present in the sample. 70% of patients had near visual acuity of N6, 17% had N8, and 13% were between N10-N12. In this study, there were only 13% emmetropes, 42% myopes, 28% hyperopes and 17% astigmatism. In the N6 group, 57.1% suffered from ocular complaints and 62.8% from headaches. In the N8 group, 88.2% had ocular strain and 94.1% had a headache. In group N10-N12, 69.2% had ocular strain and 92.3% had a headache.

Conclusions: There is a strong interconnection between refractive errors and pre-presbyopia, but a strong interconnection with asthenopia in professionals of hand-crafting occupations.

Keywords: Asthenopia, Pre-presbyopia, Refractive error

INTRODUCTION

The eye is the most important human body organ responsible for the sense of sight. We see the world with the help of our eyes.¹ Accommodation is a natural phenomenon of the human eye. The dioptric power of the eye lens increases when we look at a near object from a distance. This increase in refractive power is due to the lens curving more during accommodation. When the ciliary muscles contract, they release the tension on the lens' zonular fibers and the lens becomes more curved. This accommodative ability of the eye decreases with age. This

is referred to as presbyopia.^{2,3} When a person is young, the lens of their eye is more elastic. The ciliary muscles surrounding the lens stretch and relax to allow for the phenomenon of accommodation. With age, the lens gradually loses its ability to accommodate. As we age, blurring of near vision is a very common problem internationally. It affects almost everyone. It is called presbyopia.⁴ Asthenopia is actually a combination of headaches, eyestrain and sometimes nausea. It is often associated with close work. A person who does excessive close work suffers from asthenopia. It is also defined as eye strain associated with headaches due to excessive eye strain.⁵ Convergence insufficiency is one of the major

causes of visual fatigue, eye strain and headaches. In this problem, our eyes converge less than what is required to see a close object. This causes the person to experience eye strain and visual fatigue after working at close range for some time.⁶ Amitabha and others in his team did research on jewellery workers who perform close-up work and compared them to VDT workers and students. It was found that excessive close work and excessive use of convergence can lead to various types of visual disturbances that cause stress to the eyes. This study was conducted on 215 young men. The results showed that jewellery workers had more problems because they put more strain on their vision than the other two departments.^{4,7}

Rafael studied 87 people between the ages of 18 and 31. He conducted his research on either college students or office workers. The purpose of this study was to investigate the relationship between asthenopia and accommodation during near work. The visual status of the sample was 6/9 to 6/6. The results of this study suggest that we should establish separate relationships. The time of near work had a negative relationship with accommodative ability but a positive relationship with asthenopic symptoms.⁸⁻¹⁰ However, many people suffered from blurred vision and double vision due to near work and their accommodative ability was also reduced.^{11,12}

The basic idea of this study is to determine the role of refractive error in different types of near work. The aim of the study is to determine the effect of manual labor on different types of refractive error and whether there is a relationship between asthenopia and pre-presbyopia with this labor.

METHODS

This is a cross sectional study was conducted in Lucknow District, at the Department of Optometry, Era University, from May 2022 to June 2023. Ethical approval was obtained from the Institutional Research Ethics Committee, and the study adhered to the guidelines of the Declaration of Helsinki.

Study design

A cross sectional design with stratified sampling was used. Stratified sampling involves dividing the population into subgroups (strata) based on shared characteristics, then sampling from each group to ensure representation.

In this study, participants were stratified into two main groups: men involved in handcraft work, and women in rural areas who perform handcrafts at home.

Participants

A total of 4,800 individuals aged 16 to 35 years were included. Of these, 35% were men and 65% were women.

Inclusion criteria

Patients who had any type of refractive error, reported symptoms of asthenopia, and presbyopic individuals with near vision issues were included.

Exclusion criteria

Exclusion criteria included patients with age below 15 years; presence of cataract, amblyopia, low vision, glaucoma, or optic nerve disorders; ocular allergies or infections; and other diseases causing media opacities.

Examinations and procedures

After obtaining informed consent, a detailed medical history was recorded, including: systemic conditions (e.g., diabetes, hypertension), smoking habits, medication use, and ocular trauma or past surgical interventions

Participants then underwent a comprehensive eye examination, which included: visual acuity testing at distance (6 meters) using the Snellen chart and near (25 cm) using the N-chart, flashlight examination to assess the anterior segment, retinoscopy to identify refractive errors, digital tonometry to rule out glaucoma, and exclusion based on findings aligned with the exclusion criteria. Following the examination, a structured questionnaire was administered to assess symptoms of asthenopia, such as: headache, ocular discomfort, and nausea.

Intervention included prescribing glasses to those with pre-presbyopia and advising visual hygiene practices such as taking regular breaks for those with asthenopic symptoms or convergence insufficiency.

RESULTS

A total of 4800 patients aged 16-35 years were enrolled in this study. Of the 4800 subjects, 70% had near visual acuity of N6. 17% had N8 and 13% had N10-N12 (Table 1).

Table 1: Number of patients and percentage with categories wise near visual acuity, 70% of the 4800 individuals had near N6 visual acuity. 13% had N10–N12, and 17% had N8.

Near visual acuity	Frequency	Percentage
N6	3360	70
N8	816	17
N10-12	624	13
Total	4800	100

The subjects selected in this study were 13% emmetropic, 42% myopic, 28% hyperopic and astigmatic 17 (Table 2).

Eye strain was the main variable in this study. Out of 4800 subjects, the percentage of subjects with ocular strain was 3072 (64%) and 1728 (36%) had no eye strain. Out of them

who had eye strain, 70% had visual acuity of N6, 17% had visual acuity of N8, and 13% had visual acuity of N10-12. Among 1728 (36%) had no eye strain, 60% had N6, 7% had N8, and 33% had N10-12 visual acuity. Thus, eye strain is associated with close-range work. The Pearson chi-square showed ($p=0.052$) significant results. Headache was also associated with asthenopia. Of the N6 group, 57.1% suffered from ocular complaints and 62.8% from headaches. In the N8 group, 88.2% had ocular strain and 94.1% had headache. In group N10-N12, 69.2% had ocular strain and 92.3% had headache. The Pearson chi-square showed (0.008) significant results (Table 3).

We recommended that patients treat their problems with refractive errors by prescribing spectacle lenses, and pre-presbyopia by prescribing near additives. We also encouraged them to improve lighting. We treated convergence insufficiency with pencil push-up exercises. Some of the participants took prednisolone because they

felt it cleans the eye. We asked them to avoid self-medication. We recommended that they go for regular check-ups.

Table 2: Number and percentage of different categories of Refractive error patients (emmetropia, myopia, hyperopia and with astigmatism) 13% of the participants in this study were emmetropic, 42% myopic, 28% hyperopic, and 17% astigmatic.

Refractive error	Frequency	Percentage
Emmetropia	624	13
Myopia	2016	42
Hypermetropia	1344	28
Astigmatism	816	17
Total	4800	100

Table 3: Different types of variables and percentage of subjects with eye strain (associated with asthenopia) asthenopia was also linked to headache. Of the N6 group, 62.8% experienced headaches and 57.1% experienced ocular problems. 94.1% of the N8 group experienced headaches, and 88.2% reported eye strain. Group N10-N12 experienced 92.3% headaches and 69.2% eye discomfort.

Variables	Total (%)	Eye strain, frequency (%)		P value
		Yes (n=3072, 64%)	No (n=1728, 36%)	
Age (years)				
16-20	2020 (42)	868 (43)	1152 (57)	<0.001
21-25	711 (15)	502 (71)	209 (29)	
26-30	1191 (25)	911 (76)	280 (24)	
31-35	878 (18)	791 (90)	87 (10)	
Gender				
Male	1680 (35)	605 (36)	1075 (64)	<0.001
Female	3120 (65)	2467 (79)	653 (21)	
Refractive error				
Emmetropia	624 (13)	145 (23)	479 (77)	<0.001
Myopia	2016 (42)	1310 (65)	706 (35)	
Hypermetropia	1344 (28)	1146 (85)	198 (15)	
Astigmatism	816 (17)	471 (58)	345 (42)	
Near vision				
N6	3360 (70)	1843 (60)	1268 (60)	<0.001
N8	816 (17)	922 (30)	269 (7)	
N10-12	624 (13)	308 (10)	570 (33)	

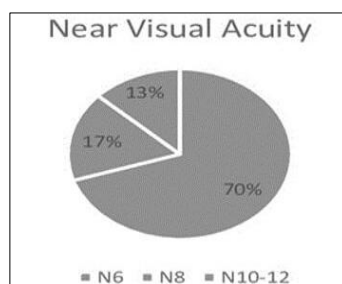


Figure 1: Distribution of patients with near visual acuity of those with eye strain, 17% had N8 visual acuity, 70% had N6 visual acuity, and 13% had N10-12 visual acuities.

DISCUSSION

Excessive near work causes some problems in our eyes, such as refractive errors, pre-presbyopia, asthenopia and convergence insufficiency. Sometimes, intraocular pressure also increases with excessive near work. The aim of our study was to investigate the relationship between near work and these problems. According to this study, there is a close relationship between near work and asthenopia, which includes eye strain, and headache. More than 60% of the patients suffered from eye strain due to close work and almost 70% suffered from headache due to close work. Refractive status showed that 85% of hyperopic patients had eye strain, it's may be due to

hyperopia influenced premature presbyopia. We considered the patients over 30 years of age as pre-presbyopic. Nearly 18% subjects were over 30 years of age and all of them were pre-presbyopic, which means that 50% of the subjects who worked near were pre-presbyopic. More than 48% of the individuals had convergence insufficiency. More than 45% of the subjects worked in inappropriate lighting. The study by Amitabha et al examined asthenopia due to close work in jewelry workers. He described that the workers worked long hours and had poor lighting. The subjects in our study were manual laborers who performed close-up work for hours at a stretch.¹²⁻¹⁴ We also checked the environment in which they worked, and almost 45% worked in low lighting. Amitabha recommended to his patients at follow-up that they increase the lighting in which they worked. At follow-up, he examined them. Their asthenopic symptoms had improved when the lighting was increased. We also recommended that our patients work at higher illuminance levels.^{4,7} The study by Unimanon et al described that illuminance levels, working distance, and constant working in close proximity lead to ocular strain. Our results are also similar regarding the effects of close work. We also recommended that patients work at a distance of more than 25 to 40 cm, illuminate the work environment, and not work continuously for 12-14 hours. We also prescribed them the 20-20-20 exercises (looking away at 20 feet for 20 seconds after every 20 minutes of close work to relieve eye strain).^{5,13,14} In that study, Unimanon suggested taking a 10-minute break after every two hours of close work. The results of his study were positive at follow-up. Improving the lighting of the work environment, shortening work hours, and taking short breaks improved the situation.¹⁵⁻¹⁷

Wholffsohn discussed in his study that eyes that work more are more prone to developing eye strain and vision problems. The main purpose of our study was to investigate the problems caused by excessive near work 18-20. The participants in our research who worked 12 to 14 hours a day had a higher chance of developing near-work-related vision problems, and they also had asthenopia, refractive error, presbyopia, and convergence insufficiency.^{13,21}

Shrewin noted that near work increases the likelihood of developing immature presbyopia and that people in developing countries such as India face cost issues. In our study, we also examined this element, but the people who did manual labor in close proximity earned money. They were independent of the cost issue. Almost all of them could afford it. If someone cannot afford glasses, the risk of developing further eye problems increases.^{4,6,20}

Lee's study examined the effects of near work on the progression or development of myopia. He considered some common risk factors such as age, near work, work status, and educational activities. He found that people who spend more time in near work have more myopic shifts or myopia, and in our study, 42% of people had

developed myopia, which means there is a correlation between myopia and near work.^{2,22}

In Karachi, Uzma studied 246 patients in OPD to find out what factors are involved in the development of myopia. She studied patients aged less than 40 years, and we took the patients aged 30-35 years as criteria for pre-presbyopia. We considered this age to ensure that patients were definitely presbyopic. It concluded that risk factors for pre-presbyopia are financial crises, social stress and sometimes occupation is a cause. In our study, we explain that proximity to work is a risk factor for the development of presbyopia.^{1,3}

Cooper studied convergence insufficiency due to excessive near work. In convergence insufficiency, the eyes cannot converge properly, and the patient therefore experiences visual disturbances. He said that convergence insufficiency may be related to accommodation.

We recommended that patients treat their problems with refractive errors by prescribing spectacle lenses, and pre-presbyopia by prescribing near additives. We also encouraged them to improve lighting. We treated convergence insufficiency with pencil push-up exercises. Some of the participants took prednisolone because they felt it cleans the eye. We asked them to avoid self-medication. We recommended that they go for regular check-ups.

Limitations

This study has several limitations. First, it was conducted at a single center—the Department of Optometry, Era University—which may limit the generalizability of the findings to other regions or populations. Second, the study design was observational and cross-sectional, which restricts the ability to establish causal relationships between refractive errors, asthenopia, and near work. Additionally, data on symptoms such as eye strain and headache were self-reported, which may introduce recall or reporting bias. The sample, although large, was limited to individuals aged 16-35 years, excluding older presbyopic populations who may experience different visual demands. Lastly, certain confounding variables such as screen time, work environment lighting, and ergonomic factors were not controlled, which could have influenced the results.

Future research involving multicenter longitudinal studies with more comprehensive control of external variables is recommended to validate and expand upon these findings.

CONCLUSION

Close work is closely related to asthenopia because many patients suffered from headaches and eye strain. Refractive errors were also present, but not to a great extent. Convergence insufficiency is also seen in these patients.

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Conflict of interest: None declared

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