

Research Article

Pre-Presbyopia, Asthenopia, and Refractive Errors are Associated among Handcrafting Workers in Lucknow

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Received: 23 January, 2025
Accepted: 11 February, 2025
Published: 12 February, 2025

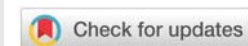
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Keywords: Asthenopia; Pre-presbyopia; Refractive error

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Abstract

Purpose: To determine the effect of handcrafting on different types of refractive errors and to verify whether there is an association between asthenopia and presbyopia with this labor. The study design was a case series study (stratified random sampling study). Study conducted in Lucknow district of Uttar Pradesh from May 2022 to June 2023.

Material and Methods: 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. 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.

Conclusion: There is a strong association between refractive errors and pre-presbyopia, but a strong association with asthenopia in workers in handcrafting occupations.

Introduction

The eye is a crucial organ in the human body responsible for the sense of sight. It enables us to observe and experience the world around us. Accommodation is a natural process of the eye that allows it to adjust focus [1]. 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 a combination of headaches, eyestrain, and sometimes nausea. It is often associated with close work. A person who does excessively 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 eye converges 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]. According to a study conducted

by Amitabha and his group on jewelry workers who perform close-up work, it was compared 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 jewelry 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 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 study aims 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.

Material and methods

Study location and duration

This study was conducted in the Lucknow District, India, from May 2022 to June 2023. Participants aged 16 to 35 years with refractive errors and asthenopic symptoms were included, while individuals under 15 years of age or those with conditions such as cataracts, amblyopia, low vision, nerve disorders, glaucoma, allergies, infections, or other diseases causing media opacities were excluded.

Study population

The study enrolled both males and females, particularly individuals engaged in manual labor such as handcrafting. The study included 4800 participants, with 35% males and 65% females. The focus was on understanding the relationship between asthenopia, refractive errors, convergence insufficiency, pre-presbyopia, and near work, especially in those who engage in close-up tasks like handcrafting.

Sampling method

A stratified sampling design was employed, dividing participants into strata based on gender and occupation (e.g., men involved in handicrafts and women from a village engaged in home-based crafts). Random sampling was conducted within each group to ensure a representative sample from both male and female participants.

Informed consent and initial screening

Informed consent was obtained from all participants before testing. A comprehensive medical history was taken, asking

about conditions such as diabetes, hypertension, smoking, and other factors affecting vision. Medication history, trauma, and prior medical procedures were also recorded.

Exclusion criteria

Participants with conditions such as cataracts, amblyopia, low vision, nerve disorders, glaucoma, allergies, infections, or other diseases affecting the eye media, as well as those younger than 15 years, were excluded from the study.

Visual and ocular examinations

Visual acuity was assessed using the Snellen chart for distance (6 meters) and the N chart for near (25 cm). The N notation chart was specifically used to measure near visual acuity and determine any refractive errors or the presence of presbyopia due to near work.

Additional methods included:

1. **Retinoscopy:** Used to assess the type and degree of refractive error in each participant.
2. **Anterior Segment Examination:** A flashlight examination of the external structures of the eye was performed to exclude any participants who met the exclusion criteria.
3. **Glaucoma Screening:** A digital screening was performed to rule out potential glaucoma.

Symptom questionnaire

At the end of the examination, participants completed a questionnaire to report symptoms related to asthenopia, including headaches, ocular discomfort, and nausea. This provided additional insight into the severity of visual strain and its relationship to near-work activities.

Treatment protocol:

- **Pre-presbyopia:** Patients diagnosed with early presbyopia were prescribed corrective glasses.
- **Asthenopia:** Participants diagnosed with asthenopia were advised to take regular short breaks during work.
- **Convergence Insufficiency (CI):** For patients diagnosed with CI, pencil push-up exercises were prescribed to improve the convergence ability of their eyes.

Statistical analysis

To assess the associations between variables such as gender, occupation, and symptoms (e.g., asthenopia, convergence insufficiency), the Pearson Chi-Square test was performed using SPSS. This test was used to determine whether there were statistically significant associations between categorical variables. For instance, it was used to explore whether certain factors, such as gender or occupation (manual labor vs. non-manual labor), were associated with the prevalence of asthenopia, convergence insufficiency, or refractive errors.

The Chi-Square test compared observed frequencies with expected frequencies for categorical variables and helped identify any significant differences or associations.

Procedure

1. The Chi-Square test was applied to categorical data, such as gender (male/female), occupation (manual labor/non-manual labor), and symptoms of asthenopia or convergence insufficiency (present/absent).
2. A p - value of less than 0.05 was considered statistically significant, indicating a meaningful association between the variables.
3. All data analysis was conducted using SPSS software.

Control of external variables (fatigue and other factors)

To minimize the impact of external variables like fatigue, the following measures were implemented:

- **Testing schedule:** Testing was scheduled during the morning or early afternoon to avoid times when participants might be more fatigued.
- **Scheduled breaks:** Short breaks were given every 20–30 minutes during testing to reduce participant fatigue.
- **Fatigue screening:** Participants were asked about their fatigue levels before testing, and those who reported significant fatigue were excluded from testing on that day.

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 and Figure 1).

The subjects selected in this study were 13% emmetropic, 42% myopic, 28% hyperopic, and astigmatic 17% (Table 2 and Figure 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 those who had eye strain, 70% had a visual acuity of N6, 17% had a visual acuity of N8, and 13% had a visual acuity of N10–N12. 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).

Discussion

Excessive near work causes some problems in our eyes, such as refractive errors, pre-presbyopia, asthenopia, and

Table 1: Near Visual Acuity.

Near Visual Acuity	frequency	percentage
N6	3360	70
N8	816	17
N10-12	624	13
Total	4800	100

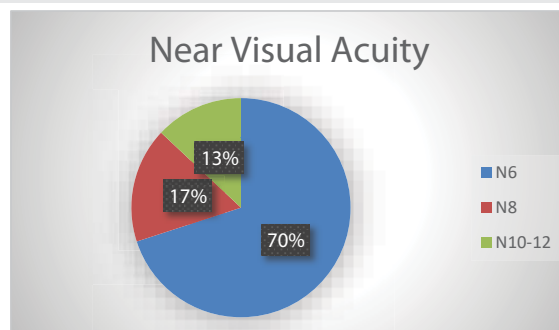


Figure 1: Near Visual Acuity.

Table 2: Refractive error.

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

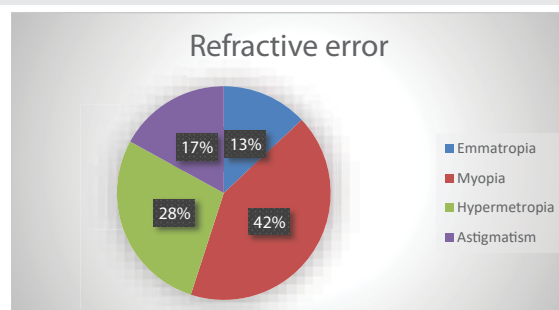


Figure 2: Refractive error.

convergence insufficiency. Sometimes, intraocular pressure also increases with excessive near work. Our study aimed 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, headache, etc. More than 60% of the patients suffered from eye strain due to close work, and almost 70% suffered from headaches due to close work. Refractive status showed that 85% of hyperopic patients had eye strain, it may be due to hyperopia-influenced premature presbyopia. We considered the patients over 30 years of age as pre-presbyopic. Nearly 18% of subjects were over 30 years of age, and all of them were prepresbyopic, which means that 50% of the subjects who worked near were prepresbyopic. More than 48% of the individuals had convergence insufficiency. More than 45%

Table 3: Eye strain with age, gender, and refractive status of the eye.

			Eye Strain		p-value
			Yes (n = 3072, 64%)	No (n = 1728, 36%)	
Variables		Total	Frequency (Percentage)	Frequency (Percentage)	
Age	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%)	

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 [12-14] hours at a stretch. 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 nearby 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 [13]. We also prescribed them the 20-20 exercises (looking away 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].

Wolffsohn 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 subjects in our study who worked 12-14 hours had a greater risk of developing eye problems due to near work, and they had positive symptoms of 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 nearby 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 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, Richdale K 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-pre-myopia. We considered this age to ensure that patients were 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].

Jaffery 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 [23].

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 their 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 checkups.

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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