OPHTHALMOLOGY | RESEARCH ARTICLE
The ocular health and visual function status of sewing professionals of garment factories of Kathmandu Valley

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Sewing professionals are engaged in extensive near work in a small and intensely condensed workspaces, thereby exposing themselves to different ocular and vision-related problems. In a cross-sectional study, 305 sewing professionals of garment factories were included and assessed for ocular and vision-related problems. The assessment included detailed anterior and posterior segment examination and vision assessment comprising of visual acuity, static refraction, dynamic refraction, eye alignment, convergence, fusional vergence, amplitude of accommodation, accommodative facility, color vision, and stereopsis. The findings were recorded on preset proforma and data were analyzed in SPSS version 20. Ocular and Vision-related problems were reported for all participants by descriptive data (number, frequency, median, IQR). The median age of the sewing professional was 30 (24–39) years with male predominance (65.2%). On anterior segment assessment, meibomitis (24.26%) was the most prevalent anterior segment disorder. Prevalence of refractive error was seen in 79.7% of the subjects of which hyperopia (44.5%) was the most prevalent form of refractive error. In participants of age group less than

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PUBLIC INTEREST STATEMENT
Sewing involves fastening or attaching objects using stitches made with a needle and thread; sewing professionals primarily sew, design, make precise patterns that require higher visual attention and are often a near-point task. Tasks are usually performed for long hours in intensely condensed workspaces, thereby exposing themselves to different vision-related problems. The manuscript consists of a study that documents the ocular and visual abnormalities in sewing professionals working in garment factories of Kathmandu valley. This study is the first of its kind in Nepal and thereby will contribute as evidence-based information to the little literature available on the ocular status of factory workers involved in prolonged near work at improper workplace setup. Awareness about the ocular status of these workers may help in understanding the risks, that the workers are exposed to and help in formulating safety guidelines in the workplace and use of proper eye-protective devices to improve eye health and efficiency of the workers.
40 years, 79.5% of the population were found to be consistent with some form of vergence and accommodative disorder; 44.5% manifesting convergence excess with accommodative insufficiency. These participants reported ocular, visual, and asthenopic symptoms at a higher rate as compared to other dysfunctions. Association between vision-related problems and symptoms was analyzed using a Chi-square test. A significance level of 0.05 was applied for a 95% confidence interval. Ocular, visual, and asthenopic symptoms were significantly associated with binocular and accommodative disorders ($r = 18.726, p = 0.04$). Ocular morbidity and binocular vision anomalies were significantly prevalent in sewing professionals of garment factories.

**Subjects:** Urban Studies; Urban Sociology - Urban Studies; Gerontology/Ageing; Human Geography

**Keywords:** oculo-visual symptoms; binocular vision; accommodative disorder; garment factory; ocular morbidity; sewing professionals

1. **Introduction**

Sewing is the craft of fastening or attaching objects using stitches made with a needle and thread. Sewing professionals are involved in sewing dresses, designing, making precise patterns requiring higher visual attention and mental concentration and are often a near-point task. Tasks are usually performed for many hours in small and intensely condensed workspaces in our country, thereby exposing themselves to different vision-related problems (Nahar et al., 2020).

Ocular disorders in factory professionals are the combination of individual visual problems, poor environmental conditions, improper work habits, high concentration, continuous looking at fixed objects and lesser blinking of eyelids (Cavalcante, MGP, SP 2014; Salve, 2015). These result in visual symptoms and, various external ocular diseases such as blepharitis, conjunctivitis, dry eye, pterygium, and pingueculae ((Omoti et al., 2009).

Continued near viewing/tasks are reported to cause visual symptoms that include blurred vision or squinting, frequently losing place when reading, diplopia, and pain in the neck, shoulder, and back (Sheedy et al., 2003). These symptoms can be associated or aggravated with refractive error and binocular vision disorders.

Even a low magnitude of hyperopia is produced by the lag of accommodation during sustained reading or near tasks, and astigmatism may cause asthenopic symptoms of an intermittent blur, headache, fatigue, loss of concentration, and inattention in some children and young individuals (Day & Duffy, 2011; Grosvenor, 1994; Hepsen et al., 2001). Similar asthenopic and visual symptoms are also caused by binocular vision anomalies; these are the most common disorder associated with prolonged reading or near activities (Hamed et al., 2013). Thus the main aim of this study is to assess and identify the oculo-visual status among the sewing professionals so that awareness can be raised regarding the use of optical devices and the need of routine eye examination. This is probably the first study of its kind in Nepal.

1.1. **Methods**

A descriptive cross-sectional study was conducted among 305 sewing professionals working in various garment factories in Kathmandu from April 2016 to November 2016. Through random sampling, a cluster of 10 garment factories was selected from which all the sewing professionals meeting the eligibility criteria participated in the study. Eligibility criteria included, participants with experience of being involved in cutting and sewing for at least one year or more, absence of any systemic disease, and full consent to participate in the study. These workers were involved in
Participants underwent detailed ocular examination; an anterior and posterior segment eye examination was carried out with a portable slit lamp and direct ophthalmoscope. Schirmer test using Whatman-41 filter paper was used to assess dry eyes; wetting of the Schirmer strip (equal to or greater than 10 mm in 5 min) was considered normal. Presenting distance and near visual acuity was assessed with a Log MAR chart at a distance of three meters and findings were recorded. Amblyopia was diagnosed when vision was 0.3 Log MAR or worse in one or both eyes after a careful eye examination including fundoscopy and cycloplegic refraction. Static retinoscopy was carried out at a distance of 50 cm with the help of a retinoscope followed by subjective refraction providing optimum visual acuity. Emmetropia was considered as spherical equivalent ≤
± 0.25D. Ishihara 38 plates edition was used to assess color vision. Out of 305 participants, only 229 participants of age less than 40 years underwent binocular vision assessment. BV assessment was performed with the best visual acuity. For participants wearing glasses, it was carried out with their present glasses and for the participants with uncorrected refractive error, the assessment was carried out after correction of their refractive error.

Sensory evaluations (Stereopsis with Titmus Fly test) followed by motor evaluations (Extraocular motility, Ocular alignment assessment by cover test) were performed. Accommodation parameters (Near Point of accommodation and Accommodative amplitude (using Royal air force ruler), Monocular and Binocular Accommodative facility (using ±2.00D flipper lens), and Dynamic Retinoscopy (using Monocular Estimation Method) were carried out. Vergence parameters (Near the point of convergence (using Royal Air Force ruler), Positive and Negative fusional vergence (using prism bar at 40 cm and 6 m) were measured. Binocular vision anomalies were diagnosed using diagnostic criteria of Accommodative and Vergence dysfunctions as mentioned by Scheiman and Wick (Scheiman & Wick, 2013).

1.2. Data analysis
Microsoft Excel 2016 and SPSS version 20.0 were used for data analysis. Data were not normally distributed and hence non-parametric statistics were applied. Median (IQR1-IQR3) values of each outcome parameter were calculated and mentioned. The frequency was expressed in the form of a percentage. The association between categorical variables was established with the Chi-square test, p value < 0.05 was considered to be significant.

2. Results

2.1. Socio-demographic characteristic
Three hundred and five sewing professionals participated in the study with 229 (75.08%) participants between the age group 14–39 years and the rest 76 participants (24.91%) were presbyopic. The median age of the population was 30 (24–39) years. Males predominated the study with 65.2% There was no significant difference of age between males and females (p = 0.332) as shown in Table 1

2.2. Ocular disorders
Of 305 total participants, 181 participants (59%) presented with visual acuity (VA) of less than or equal to 0.1 log Mar (Figure 3) including spectacle users as well. The median VA is 0 (0–0.2) log MAR. One hundred and twenty-four participants had some form of refractive error and were not using any optical correction; therefore they were first corrected and further assessed for prevalence of any binocular vision anomalies. There was no significant difference in visual acuity between the two eyes (p = 0.09), therefore, only the results for the right eyes were reported.

On anterior segment evaluation, 168 participants had normal anterior segment; Meibomitis and pinguecula was the most prevalent form of anterior segment disorder with a prevalence of 24.26% and 9.83% respectively. Hyperopia was the most prevalent refractive error (44.6%) followed by

| Table 1. Age and sex distribution |
|-----------------------------------|
| Variables                        | Frequency | Percentage (%) |
| Age group                        |           |                |
| >40 years                        | 75        | 24.59          |
| < 40 years                       | 229       | 75.41          |
| Sex                              |           |                |
| Male                             | 199       | 65.24          |
| Female                           | 106       | 34.75          |
| Median age (IQR1-IQR3) years     | 30 (24–39)|                |
Table 2. Distribution of ocular disorders

| Ocular disorders (n = 305)                     | Frequency | Percentage (%) |
|-----------------------------------------------|-----------|----------------|
| Anterior segment disorders (ASD)              |           |                |
| Without ASD                                   | 168       | 55.08          |
| Meibomitis                                     | 74        | 24.26          |
| Pinguecula                                     | 30        | 9.83           |
| Blepharitis                                    | 13        | 4.26           |
| Ocular allergy                                 | 10        | 3.27           |
| Conjunctivitis                                 | 04        | 1.31           |
| Pterygium                                      | 03        | 0.98           |
| Dry eyes                                       | 21        | 6.9            |
| Refractive error (n = 305)                     |           |                |
| Emmetropia                                     | 62        | 20.3           |
| Hyperopia                                      | 136       | 44.6           |
| Myopia                                         | 57        | 18.7           |
| Astigmatism                                    | 50        | 16.4           |
| Accommodative and vergence disorders (n = 229) |           |                |
| No dysfunctions                                | 47        | 20.5           |
| Convergence excess with accommodative insufficiency | 102        | 44.5           |
| Fusional vergence dysfunction                  | 23        | 10             |
| C ![Image: Figure 3. Distribution of presenting visual acuity.](image)

Figure 3. Distribution of presenting visual acuity.
myopia (18.7%) and astigmatism (16.4%). Schirmer’s test for dry eyes assessment showed 6.9% had dry eyes. Colour vision test revealed a normal pattern in 95.1%, 3.9% with deutan defect, and 1% with protan defect. Of the nonpresbyopic population (n = 229), binocular vision disorder was assessed and evaluated, which revealed 182 participants with some form of vergence and accommodative disorder. (Table 2)

2.3. Symptoms
Out of 305 participants, 78.4% reported some form of ocular or visual symptoms associated with their work. Out of which asthenopic symptoms were the most prevalent with 38.7%, followed by ocular surface-related symptoms with 21% (Table 3).

Symptoms distribution was assessed in participants in age groups less than 40 years. These participants were grouped into three groups: without dysfunctions, refractive dysfunctions and binocular vision, and accommodative dysfunctions. Refractive error presented with some form of vergence and accommodative disorder are classified and included in the vergence and accommodative disorder group. Of the presented symptoms, asthenopic symptoms were the most prevalent in both dysfunctions with 87.64% in the vergence and accommodative disorder group. There was a significant association between symptoms experienced and vergence and accommodative disorder (r = 18.726, p = 0.04). (Table 4)

| Table 3. Frequency of symptoms |
|--------------------------------|
| Symptoms (n = 305) | Frequency | Percentage (%) |
| No symptoms | 66 | 21.6 |
| Asthenopic symptoms | 118 | 38.7 |
| Ocular-surface-related symptoms | 64 | 21 |
| Visual symptoms | 57 | 18.7 |

| Table 4. Distribution of symptoms in nonpresbyopic participants with refractive and binocular vision and accommodative disorder |
|-----------------------------------------------------------------------------------------------------------------
| Symptoms (n = 305) | No dysfunctions | Refractive dysfunctions | Vergence and accommodative disorder | Total |
|-------------------|----------------|-------------------------|-------------------------------------|-------|
| No symptoms       | 3 (4.92%)      | 14 (22.95%)             | 44 (72.13%)                         | 61 (100%) |
| Ocular surface disorders symptoms | 7 (12.5%) | 7 (12.5%) | 42 (75%) | 56 (100%) |
| Visual symptoms (Blurring of near and distance vision) | 1 (4.34%) | 4 (17.39%) | 18 (78.26%) | 23 (100%) |
| Asthenopia (Headache, Eyeball a/w Eye ball ache, Pulling eyes) | 3 (3.37%) | 8 (8.99%) | 78 (87.64%) | 89 (100%) |
| Total             | 14 (6.11%)     | 33 (14.41%)             | 182 (79.48%)                        | 229 (100%) |
| p-value           | 0.194          | 0.044*                  |                                    |       |

*significant for p value <0.05 by Chi-square test
2.4. Refractive error and binocular vision and accommodative disorder

Out of 229 non-presbyopic populations, 75.9% (174) participants presented with some form of refractive error. The median spherical value was 0.50 (~−0.25−0.75) D and median astigmatic value was −0.50 (~−0.75~(−0.50)) D. A high number of participants with refractive error (61.57%) presented with some form of binocular vision and accommodative disorder but no significant association found between two entities (p = 0.197). (Table 5)

2.5. Discussion

As far as we know, this is the first study that addressed the ocular and visual problems in sewing professionals of Nepal.

Prevalence of various types of ocular disorders along with vergence and accommodative disorder in sewing professionals working in garment factories were identified. The prevalence of the disorders among these workers may be directly related to their workplace and the nature of the work involved.

Out of 305 participants, 41.80% of the subjects had anterior segment disorders with meibomitis (24.26%) being most prevalent followed by pinguecula. The pattern of ocular disorders found in our study is relatively similar to the study in Nigeria where 66% of the workers had ocular disorder (Omoti et al., 2009). A Study in industrial mine workers reported similar findings with pterygium/ pingueculae (25.8%) being most prevalent and cataract (7.4%) being least (Ovenseri-Ogboro et al., 2012). Whereas morbidity pattern in the leather industry in Chennai revealed 6.5% with ocular problems which are similar to a study conducted on female garment workers in Bangladesh where workers manifested fewer eye problems as compared to other morbidities (Ay, R. Ud, J. K., 2014)(Dergisi & Sciences, 2014) (Chiemeke et al., 2007). This difference could be because of the nature of the work involved. The working environment was not well supported with lights and ventilation making it riskier to perform near visual tasks. The presence of ocular surface disorders could be because of the unhygienic environment, exposure to chemicals, bleaching agents, and dust coming from cutting and sewing fabrics.

| Table 5. Proportion of refractive error within binocular and accommodative disorder among cases <40 years |
|---------------------------------------------------------------|
| Binocular vision and accommodative disorders | Refractive error | Total |
| | Emmetropia | Hyperopia | Myopia | Astigmatism |
| No dysfunction | 14(29.80%) | 8(17%) | 13(27.7%) | 12(25.5%) | 47(100%) |
| Convergence insufficiency | 6(31.6%) | 6(31.6%) | 5(26.3%) | 2(10.5%) | 19(100%) |
| Fusional vergence dysfunction | 4(17.4%) | 6(26.1%) | 9(39.1%) | 4(17.4%) | 23(100%) |
| Convergence excess | 4(21.1%) | 10(52.6%) | 2(10.5%) | 3(15.8%) | 19(100%) |
| Accommodative insufficiency | 3(27.3%) | 2(18.2%) | 2(18.2%) | 4(36.4%) | 11(100%) |
| Accommodative excess | 0(0%) | 0(0%) | 7(87.5%) | 1(12.5%) | 8(100%) |
| Convergence excess and accommodative insufficiency | 24(23.5%) | 55(53.9%) | 10(9.8%) | 13(12.7%) | 102(100%) |
| Total | 55(24%) | 87(38%) | 48(21%) | 39(17%) | 229(100%) |
Ocular symptoms were found in 78.4% of the subjects of which 38.7% of the participants manifested asthenopic symptoms. These symptoms were manifested in higher proportions by participants with accommodative and vergence disorder. This is similar to a study done among jewelers in which 65.22% of the jewelry manufacturing workers were suffering from the symptoms like CVS (Salve, 2015). Swelling and jewelry workers have a long duration near works and present more visual and asthenopic symptoms (Chiemeke et al., 2007; Lodin et al., 2012), which has been consistent with our study too. When near work is performed, accommodation, convergence, and meiosis occur with which extraocular muscles contract for the respective movement resulting in eyestrain (Fisher, 1977; Pang et al., 2015; Salve, 2015) therefore headache and eyeball ache become the most prevalent asthenopic symptom in 38.7% of participants. Vergence disorders are usually associated with accommodation, with prolonged use of eyes for near activities. Similarly, overconvergence can occur result in less accommodative demand (American Optometric Association, 2011; Wolffsohn et al., 2011), causing the reason of convergence excess with secondary accommodative insufficiency being prevalent in 44.7% of participants. The findings are in contrast to other studies where accommodative insufficiency and convergence insufficiency are a frequent occurrence in near work demands (Bartuccio et al., 2008; Sterner et al., 2006). This could differ because most of these studies were conducted in children and very few in near-work occupational settings. Fusional vergence dysfunction was reported by 10.04% of the participants below 40 years of age who underwent binocular vision assessment. This is usually seen when subjects notice asthenopia (Cooper et al., 2010).

Refractive error was the most significant finding with a prevalence of 79.7%. This was slightly greater than that found in electronic and jewelry workers in Thailand which was 52% (Untimanon et al., 2006). Hyperopia (44.6%) was the most prevalent refractive error in our study which was most prevalent in the age group 25–30 years. Lag of accommodation is generally seen with hyperopic error (Candy et al., 2012; Sivaraman et al., 2015), so the prevalence of hyperopic error in our study could be due to lag of accommodation associated with prolonged and longer duration of near work.

2.6. Limitations of the study

The study was carried out in a community setup, although carried out in a specific manner, there were some limitations. To address oculo-visual status in respect to the participant's view, a symptom survey with severity level is necessary. Sewing professionals are involved in various types of work, which needs to be studied separately and has to be correlated separately with the ocular findings. The follow-up study was not carried out, hence the long-term ocular effect of the nature of work could not be correlated. In addition, being a noninterventional study, the outcome of treatment and eye exercises on visual performance could not be studied. Many studies are carried out in industrial setup but very few are carried out in garment factories. Further studies are required to address the true relation between the symptoms experienced and ocular disorders present.

3. Conclusion

The nature of work and improper workplace setup has posed an ocular risk to sewing professionals. Hyperopia and convergence excess with accommodative insufficiency were the most prevalent form of refractive error and accommodative and vergence disorder respectively found in our study. Therefore, periodic eye checkups, safety guidelines in the workplace, and the use of proper eye-protective devices can improve the eye health and efficiency of the workers.

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The authors declare that they have no competing interests.

Author contributions
SS, RKS, SM, GBS, and AKS were involved in the concept and design of the study. SS shares the first authorship and was involved in the data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review and literature search. RKS was involved in manuscript editing and manuscript review and literature search. SS, RKS, SM, GBS, and AKS worked on editing and revising the manuscript. All authors have read and approved the final manuscript.

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