Visual problems among video display terminal (VDT) users in Nepal

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Keywords
VDT; Symptoms; Ocular changes; Nepal

Abstract
Purpose: To evaluate visual problems, major symptoms, and their associations among VDT users in Nepal.

Methods: Among 76 hospital attendees, assessment included visual acuity, retinoscopy, convergence, accommodation, fusional vergence and Schirmer’s II. Subjects’ symptoms were recorded in the structured 5 point intensity scale questionnaire.

Results: Mean age of subjects was 25.8 ± 5 years with 6.9 ± 2.6 hours/day of computer use. Ocular changes were reported in 92.1 % of the total subjects. The common ocular change was accommodative infacility. The most common symptoms (p < 0.001) were tired eye and headache. Reduced tear secretion as indicated by Schirmer’s test II was found to have a little role in manifesting the symptoms as indicated by regression coefficient.

Conclusions: Accommodative infacility and tired eye were the most common abnormalities and symptom reported. Schirmer’s test II was slightly correlated with some ocular, visual, and systemic symptoms.

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Problemas visuales en usuarios de terminales de visualización de video (VDT) en Nepal

Resumen
Objetivo: evaluar los problemas visuales, los síntomas principales y sus asociaciones en usuarios de VDT en Nepal.

Métodos: se realizaron evaluaciones en 76 pacientes del hospital que incluyeron agudeza visual, retinoscopia, convergencia, acomodación, convergencia de fusión y la prueba de Schirmer II. Los síntomas de los sujetos se registraron en el cuestionario estructurado con una escala de intensidad de 5 puntos.

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Introduction

The Video Display Terminals (VDTs) are becoming commonplace items today. Many individuals who work with a computer experience eye-related discomforts or visual problems. However, it is unclear whether these problems occur to a greater extent in computer workers than in workers in other highly visually demanding occupations. Yeow (1989 and 1991) reported that VDT work didn’t have a significantly greater effect on visual function. Vision problem in VDT users were generally temporary.

Apart from the computer usage, ergonomics of furniture used, source of glare, temperature, humidity, location of VDU, job related task, environmental factors and defect of vision are essential to avoid computer vision syndrome.

Use of VDTs is on the rise to Nepalese work places owing to growing trend towards office computerization. This study was conducted to determine the causes of ocular abnormalities; identify the major ocular, visual, and systemic symptoms; and find out their associations among VDT users in hospital attendees in Nepal.

Methods

Study design and subjects

Initial 76 subjects, who visited to B.P. Koirala Lions Centre for Ophthalmic studies (BPKLOCS), Institute of medicine, were enrolled in the study from February 2009 to July, 2009. It included 18 (23.7%) students (bachelor and master level), 14 (18.4%) computer operators (software engineers, wave designers, and data analysts), 20 (26.3%) office workers (clerical staffs, administrative officers, secretaries, receptionists, and project officers), 11 (14.5%) bank workers (cashiers, accountants, and bank clerks) and 13 (17.1%) others (teachers, tour operators, and photographers). The purpose of the study was clearly explained and verbal consent was taken from each subject. Subjects were enrolled in the study on the basis that they worked on computer for minimum of two hours per day (Table 1).

Subjects with best corrected vision less than 6/9 (20/30), presbyopia, ocular pathology, strabismus, contact lens wearers and unwilling to participate in the study were excluded from the study.

Assessment

The assessment involved structured questionnaire concerning subjective symptoms and determination of the ophthalmologic routine status. The questionnaire was collected and the eye examination was conducted the same day by an ophthalmologist and an optometrist. Complete
medical history was recorded to exclude any systemic
disease, ocular disease or use of medication.

Visual acuity: Monocular visual acuity was measured and
recorded with an internally illuminated Snellen chart at
distance of 6m under normal lighting condition. Near visual
acuity was measured at 35-40 cm.

Ophthalmic examination

All subjects underwent a complete ophthalmic
examination of anterior segment with slit lamp and
posterior segment with direct ophthalmoscopy. Indirect
binocular ophthalmoscopy was carried out after dilatation
with tropicamide 0.5 % eye drop when it was found
necessary.

Refraction

Static and subjective refraction were carried out in every
subject. A change or presence in spherical equivalent
refractive error equal to or greater than ± 0.50 D was
considered significant. Dynamic retinoscopy was carried out
at 35-40 cm by monocular estimation method. Normal lag of
accommodation was considered as ± 0.75 D.

Cover test

Ocular alignment was assessed by means of cover test at six
meter distance and at 40 cm distance. No movement on
cover test was considered as orthophoria. Esophoria was
considered significant when outward latent deviation
exceeded four prism diop ters at distance and six prism
diopters at near. Esophoria was considered significant when
inward deviation exceeded two prism diopters at distance
and four prism diopters at near.

Positive fusional vergence

Vergence amplitude was measured at 40 cm and 6 m
with the help of horizontal prism bars placing base out
before subject’s one eye and increasing power of prism
gradually unless subject noticed first blur, break and
recovery. Morgan’s norm was considered as normal score
for near (17/ 21/ 11) and distance (9/ 19/ 10) fusional
vergence.

Near point of convergence

Near pint of convergence was measured with Royal Air Force
rule at primary gaze by moving the single dot target on the
rule along the scale towards the eye. Convergence of less
than 10 cm was considered normal, 11-15 cm reduced
and ≥ 15 cm was defective.

Amplitude of accommodation

Amplitude of accommodation was measured on Royal Air
Force rule with N6 target letter. The print was then moved
towards the subject until the letters became illegible.
Normal value of amplitude of accommodation was
calculated by the Hofsetters formula [Amplitude of
accommodation = 16-(Age/ 4)].

Accommodative facility

Accommodative facility was measured with ± 2.0 D binocular
flipper lens at 40 cm distance viewing target letter size
equivalent to N8. The diagnostic criterion was set at
10 cycles per minute binocularly. Below this score was
considered abnormal.

Schirmer’s test II

Schirmer’s test II was carried out to calibrate amount of
basic tear secretion using Whatman-41 filter paper 5 minutes
after instillation of 2% lidocaine eye drop. Wetting scale of
less than 10 mm in 5 minutes was considered abnormal.

Structured questionnaire

Structured questionnaire included four sections concerning
duration of computer use, intensity of ocular symptom
(watery, feeling of dryness, itching, P ain behind eye, Aching,
soreness, and tiredness), visual symptom (Blurred vision and
Doubled vision), and systemic symptom (Shoulder pain, Neck
pain, Back pain, and Headache). The symptom scores were
ranked on intensity rating as 0 = none or asymptomatic,
1 = very mild, 2 = mild, 3 = moderate, 4 = intense, and 5 = very
intense. The subjects were asked to state the occurrence of
symptom and specify the hours at which they did VDT work,
performed other work, or took breaks. Symptoms were
entered in to statistical analysis using this intensity rating
scale. Questionnaire is available in Appendix I.

Statistical analysis

All data were evaluated using statistical tools in statistical
package for social science (SPSS version 14). Variance of age
and duration of computer use was analysed for sexes using
unpaired t-test. Ocular abnormalities and symptoms were
analyzed using non-parametric test using Mann-Whitney U
test for two different unmatched subject groups and Kruskal
Wallis test for three or more unmatched subject groups.
Chi-Square test was performed to assess correlation between
symptoms with ocular abnormalities and gender differences.
Multiple regression analysis was also used to assess the
correlation between each dependent variable (ocular
symptoms, visual symptoms, and systemic symptoms) and
independent variables (duration of computer use in hours
per day, accommodative abnormalities, convergence
abnormality, fusional insufficiency, and reduced tear
secretion). Independent variables were selected for each
dependent variable by “enter” variable selection method.
Confidence interval was considered at 95% level. P-value
was considered significant for less than 0.05.

Results

Demographic profile of subjects, and ocular
abnormalities

A total of 76 subjects were enrolled in the study (Table 1).
Mean age of the subjects was 25.8 ± 5 years (male 26.6 ± 5 years
and female 24.3 ± 4.4 years). Male constituted 53 subjects
Symptoms reported for gender difference and sore eye (n = 2), headache (n = 85.5% 173 13.3 3). The three most commonly reported symptoms (Table 2). The three most commonly reported symptoms were sore eye (n = 112, total score 8.6% Median 2), ocular symptom was doubled vision (n = 2, total score 1.2% Median 2). Ocular symptom scores (Kruskal-Wallis test, p = 0.019) and systemic symptom scores (Kruskal-Wallis test p = 0.006) were significantly different within the groups. But visual symptom scores (Mann-Whitney test p = 0.09) was insignificant. Symptom scores were also different among all the groups (Kruskal-Wallis test p = 0.005). All the symptoms were particularly insignificant between male and female.

Multiple regression analysis between symptoms and ocular findings

Table 3 contains the standard regression coefficients and adjusted R² value of multiple regression analysis. For all symptoms, the independent variables selected by the enter selection method included all the ocular abnormalities and duration of computer work in hours per day. Adjusted R² value for pain behind eye (p < 0.01), aching eye (p = 0.02), and double vision (p = 0.02) were 0.3, 0.1, and 0.1 respectively. Regression coefficient of ocular findings showed sporadic and minor influence on symptoms. However, abnormal Schirmer’s test II was found to be a relative predictive factor to cause some form of the symptoms like pain behind eye (β = 0.5, p < 0.01), aching eye (β = 0.4, p < 0.01), total ocular symptoms (β = 0.3, p = 0.03), double vision (β = 0.3, p = 0.01), neck pain (β = 0.3, p = 0.04), and total symptoms (β = 0.3, p < 0.01).

Discussion

This study reported the ocular abnormalities detected in computer users, and identified the major ocular, visual, and systemic symptoms in hospital attendees in Nepal. However, correlation between these abnormalities and symptoms was not so significant.

### Table 2 Distribution of symptom scores

<table>
<thead>
<tr>
<th>SN</th>
<th>Ocular symptoms</th>
<th>Symptom reported for at least once</th>
<th>Total scores</th>
<th>Percentage symptom score</th>
<th>M</th>
<th>Gender difference (Chi square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Watery eye</td>
<td>59.2%</td>
<td>88</td>
<td>6.7</td>
<td>3</td>
<td>χ² = 6.3, df = 3, p = 0.09</td>
</tr>
<tr>
<td>1</td>
<td>Dry eye</td>
<td>61.8%</td>
<td>105</td>
<td>8.1</td>
<td>2</td>
<td>χ² = 4.7, df = 4, p = 0.31</td>
</tr>
<tr>
<td>2</td>
<td>Itchy eye</td>
<td>48.7%</td>
<td>63</td>
<td>4.9</td>
<td>1</td>
<td>χ² = 2.7, df = 3, p = 0.44</td>
</tr>
<tr>
<td>3</td>
<td>Pain behind eye</td>
<td>42.1%</td>
<td>66</td>
<td>5.1</td>
<td>2</td>
<td>χ² = 2.9, df = 3, p = 0.44</td>
</tr>
<tr>
<td>4</td>
<td>Aching eye</td>
<td>61.8%</td>
<td>101</td>
<td>7.8</td>
<td>2</td>
<td>χ² = 2.9, df = 4, p = 0.56</td>
</tr>
<tr>
<td>5</td>
<td>Sore eye</td>
<td>71.1%</td>
<td>112</td>
<td>8.6</td>
<td>2</td>
<td>χ² = 3.7, df = 3, p = 0.29</td>
</tr>
<tr>
<td>6</td>
<td>Tired eye</td>
<td>88.2%</td>
<td>163</td>
<td>12.5</td>
<td>2</td>
<td>χ² = 11.54, df = 4, p = 0.02</td>
</tr>
<tr>
<td>7</td>
<td>A. Visual symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Blurred vision</td>
<td>64.5%</td>
<td>107</td>
<td>8.4</td>
<td>2</td>
<td>χ² = 1.6, df = 3, p = 0.66</td>
</tr>
<tr>
<td>2</td>
<td>Double vision</td>
<td>11.8%</td>
<td>16</td>
<td>1.2</td>
<td>2</td>
<td>χ² = 1.76, df = 2, p = 0.41</td>
</tr>
<tr>
<td></td>
<td>Shoulder pain</td>
<td>51.3%</td>
<td>86</td>
<td>6.6</td>
<td>2</td>
<td>χ² = 5.73, df = 3, p = 0.12</td>
</tr>
<tr>
<td>1</td>
<td>Neck pain</td>
<td>67.1%</td>
<td>109</td>
<td>8.2</td>
<td>2</td>
<td>χ² = 5.24, df = 3, p = 0.15</td>
</tr>
<tr>
<td>2</td>
<td>Back pain</td>
<td>61.8%</td>
<td>112</td>
<td>8.6</td>
<td>2</td>
<td>χ² = 0.28, df = 3, p = 0.96</td>
</tr>
<tr>
<td>3</td>
<td>Headache</td>
<td>85.5%</td>
<td>173</td>
<td>13.3</td>
<td>3</td>
<td>χ² = 4.14, df = 4, p = 0.38</td>
</tr>
<tr>
<td></td>
<td>Systemic symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M: median; confidential interval 95% p: Value significant at level of 0.05.

Kruskal-Wallis test (ocular symptoms, p = 0.012; systemic symptoms, p = 0.006).

Mann-Whitney test (visual symptoms, p = 0.09).
Ocular abnormalities were seen in 92.1% (Table 1). The three commonest ocular abnormalities were accommodative infacility in 35.5% fusalional insufficiency in 14.8% and lag of accommodation in 13.6%. The higher incidence of abnormality was not unexpected because the subjects, who visited to hospital seeking eye and vision care, were enrolled in the study.

Symptoms in VDT users were vague and reported different in different literatures. The ocular complaints experienced by computer users typically include eye strain, eye fatigue, burning sensations, irritation, redness, blurred vision, and dry eyes. Non-ocular symptoms include headaches, pain in the shoulders, neck, or back. However, eye related symptoms were reported as the most common health problem among VDT users. 

Edema reported tired eye (62.5%), blurred vision (59.4%) and itching (59.4%) were the three major or subsequent symptoms reported in spectacle wearer than non wearer. In another study, eye strain (91%), painful or stiff neck and shoulder (81%), and burning eyes and irritability (80%) were the symptoms frequently reported. Headache (41.78%), eye strain (26.72%), pain (31.51%) and lacrimation (19.86%) were the most prevalent visual symptoms among non-presbyopic VDT users. We have found the tired eye was the most common symptom reported by 88.2% (Table 2). Headache was the most intense symptom represented by 13.3% of total symptom score. These symptoms were followed by tired eye (12.5%), sore eye (8.6%) and back pain (8.6%). Symptom recorded in our study was high. There could be various reasons: subjects were hospital visitors seeking eye examination, fewer and common symptom categories were used, and subjects had possibility of recall the symptom during the time of computer use. However, Cole et al. found the contrasting report which stated there was no clear trend to lend VDU work as a risk factor in 6-year longitudinal study.

Accommodative change comprising of accommodative insufficiency (9.7%), accommodative infacility (35.5%), and lag of accommodation (13.6%), was found in 58.8% of total abnormalities diagnosed. Higher incidence of accommodative dysfunction was also reported previously in different studies. Gur and Ron reported decreased accommodative and convergence range significantly before and four days after work on computer. Daum reported blur, headache, and asthenopia were the most common symptoms noted in a retrospective study of patient records containing a diagnosis of accommodative insufficiency. Spending long time on computer screen without pause also can lead to problem of shifting focus screen, documents and keyboard. The constant process of drifting and refocusing on fuzzy pixel of texts on computer screen can leave eyes strained and fatigued. Marginal accommodative response and binocular vision problem can diminish power of accommodation, remove the near point of convergence, and show phoria for near vision in prolong VDT use.

Binocular vision change comprising of convergence insufficiency (9%) and fusional insufficiency (14.8%) was 23.8% of total abnormalities diagnosed. Dain reported significant association between near horizontal phoria and symptoms among VDT users. Gur reported low fusional vergence in 46.9% heterophoria in 34.4% and convergence insufficiency in 28.1% in computer users than control. Yekta reported phoria findings and binocular vision anomalies significantly increased at the end of the working day. In our study, exophoria at distance was recorded as 13.2% and near was 15.8% of total subjects in our study. The

<table>
<thead>
<tr>
<th>Table 3 Standard regression coefficient and Adjusted R² Value in Multiple Regression Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
</tr>
<tr>
<td>Watering</td>
</tr>
<tr>
<td>Dry eye</td>
</tr>
<tr>
<td>Itchy eye</td>
</tr>
<tr>
<td>Pain behind eye</td>
</tr>
<tr>
<td>Aching eye</td>
</tr>
<tr>
<td>Sore eye</td>
</tr>
<tr>
<td>Tired eye</td>
</tr>
<tr>
<td>Total ocular symptoms</td>
</tr>
<tr>
<td>Blurred vision</td>
</tr>
<tr>
<td>Double vision</td>
</tr>
<tr>
<td>Total visual symptom</td>
</tr>
<tr>
<td>Shoulder pain</td>
</tr>
<tr>
<td>Neck pain</td>
</tr>
<tr>
<td>Back pain</td>
</tr>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Total systemic symptoms</td>
</tr>
<tr>
<td>Total symptoms</td>
</tr>
</tbody>
</table>

Less than 0.05.
Less than 0.01.
AF: accommodative infacility; Al: accommodative insufficiency; CI: convergence insufficiency; DOW: duration of computer work use in hours per day; Fr: fusional insufficiency; LAG: lag of accommodation.
magnitude of the phoria did not correlate with the incidence of symptoms in our study and the finding was comparable to the Collins report. Grisham reported headaches, eyestrain, and eye fatigue as symptoms commonly related to convergence insufficiency and to minor disorders of ocular vergence. However, convergence insufficiency was not significantly correlated with symptoms in our study.

Dry eyes appeared to be major or contributor to symptoms of computer vision syndrome. Computer users often report complaints of eye dryness, burning, grittiness, heaviness, or watering on extended period of computer work. Dry eye can manifest as a result of decreased blink rate and prolonged exposure of ocular surface causing deactivation of the eye. Environmental factors such as working in an air conditioned room, dry air, or ventilation fan can also precipitate dry eye. In our study, most of the participants were office workers, bank workers, and computer operators. They might be exposed to the air-conditioned environment during office work. Incidence of dry eye could be anticipated more than the finding we reported (Table 1). This study couldn’t assess the battery of test that could have been of much help in diagnosis of dry eye. That might be the reason that we reported dry eye slightly less than the finding reported in other studies. Nakashish reported dry eye in 33.9% and associated with asthenopic symptom in VDT users. Toda reported diagnosed dry eye in 51.4% patients complaining of ocular fatigue.

Correction of refractive error and wearing properly prescribed glasses were much more powerful factors relieving asthenopic symptoms in VDT users. Smith MJ, Cohen BCF, Stammerjohn LW. An investigation of accommodation and vergence dysfunctions. However, dry eye was significantly correlated with a small proportion of symptoms. These findings warrants a need of detailed and dedicated evaluation of condition of tear film and associated abnormalities. To identify the root cause of potential health problem, further study can be conducted considering work place environment that can have an effect on causing dry eye. A careful eye examination should be conducted to reveal an ocular complaint associated with VDT usage. Various ocular abnormalities need to be carefully treated to reduce the intensity of symptoms though they were confounded to each other.

Conflict of interests

Authors declare that they don’t have any conflict of interests.

Acknowledgement

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