

# A COMPARISON OF SUBJECTS with CONVERGENCE INSUFFICIENCY and SUBJECTS with NORMAL BINOCULAR VISION Using A Quality Of Life Questionnaire

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## Abstract

*The purpose of this study was to investigate whether symptoms of subjects diagnosed with convergence insufficiency (CI) were statistically different from those subjects with normal binocular vision (NBV), using the College of Optometrists in Vision Development-Quality of Life (COVD-QOL) questionnaire. Some 129 charts from the Northeastern State University Oklahoma College of Optometry's (NSUOCO) vision therapy clinic were retrospectively reviewed and separated into three groups; those diagnosed with CI, those with normal binocular vision and those not fitting the criteria for either group 1 or 2. Each symptom on the COVD-QOL was analyzed for its prevalence and severity in groups 1 and 2. The data was evaluated, using the student t-test. Two of the 30 symptoms listed in the COVD-QOL checklist were statistically significant at the .05 level of confidence; and two others approached significance for subjects with CI when compared to those with NBV. A definite discrimination between the two groups, CI and NBV, could not be made using any other symptom on the COVD-QOL questionnaire.*

## Key Words

*College of Optometrists in Vision Development Quality of Life Questionnaire (COVD-QOL), convergence insufficiency, Convergence Insufficiency Reading Study (CIRS), normal binocular vision, quality of life*

## INTRODUCTION

**B**inocular visual anomalies are common dysfunctions that often vary symptomatically, and can potentially reduce visual performance and/or comfort.<sup>1-11</sup> The standard of care for the management of these anomalies is optometric vision therapy (VT), which includes lens and prism application.<sup>4,12-20</sup> The conditions that are subsumed in this area of optometric care are anomalies of the visuomotor, ocular motor, binocular, accommodative, and information processing components of the visual system.<sup>12</sup> Previous studies by Montes-Mico<sup>1</sup> and Hokoda<sup>3</sup> have shown a high association between the prevalence of binocular vision disorders and visually related complaints. These binocular disorders can interfere with maximum visual performance, and are most often exhibited during nearpoint activities.

Quality of life (QOL) factors are becoming increasingly important, especially in this era of assessment and accountability.<sup>21-24</sup> Assessment of QOL factors is beneficial for the provider for symptom evaluation and to patients' third party providers in determination of treatment success.<sup>16,25</sup> These factors are becoming increasingly important in managed care reimbursement and the cost containment arena. Although a concrete definition of QOL has yet to be established, QOL factors directly impact the morbidity of disease. The QOL can be measured through a questionnaire. QOL information has traditionally been gathered before the examination in an informal case history. When

individual needs are assessed, better management decisions can be made. Quantifiable QOL measures have been proposed to evaluate treatment modalities or to compare experimental and control groups.<sup>22</sup>

The College of Optometrists in Vision Development (COVD) developed a one page questionnaire (COVD-QOL) of 30 items that assesses subjective changes in a patient's behavior and performance associated with binocular visual anomalies. See Appendix A.<sup>22-24</sup> QOL symptom/treatment evaluation has proven to be reliable, valid, and appropriate for these anomalies.<sup>21,23,24</sup> In a study by Maples, it was demonstrated that the COVD-QOL checklist could be used confidently to monitor patient symptoms before, during and after VT.<sup>23</sup>

The purpose of the present study was to assess statistical significance of the symptoms specified on the COVD-QOL in subjects diagnosed with convergence insufficiency (CI), as compared to those with normal binocular vision (NBV).

## SUBJECTS

A total of 21 subjects who fit the diagnostic criteria, CI or NBV (as defined in the next section) were included in this study. They ranged in age from 7-19 years, with an average age of 11.0 years, and were age and sex matched between the two groups.

Subjects with diagnosed learning disabilities, attention deficit hyperactivity disorder, corrected visual acuity less than 20/25, strabismus, or ocular pathology were excluded from the study.

## MATERIALS and METHODS

A total of 129 charts of patients who had been examined at the Northeastern State University Oklahoma College of Optometry's (NSUOCO) VT Clinic were retrospectively reviewed and separated into three groups by one of the authors (T.W.). Group 1 consisted of 10 patients whose VT evaluations had resulted in the diagnosis of convergence insufficiency (CI). This diagnosis was based on the clinical findings at the initial exam and the basic clinical signs used in the Convergence Insufficiency in Reading Study (CIRS).<sup>26</sup> These signs are:

1. exophoria at near of at least 4 prism diopters ( $\Delta$ ) greater than the distance heterophoria;
2. insufficient positive fusional vergence (failing Sheard's criterion of at least 12  $\Delta$  BO to blur or 15  $\Delta$  to BO break);
3. receded nearpoint of convergence (NPC) (i.e. greater than 7.5cm break or 10.5cm recovery).

CI was diagnosed when at least two signs were present (high suspect CI) or if all clinical signs were present (definite CI).

Group 2 consisted of 11 patients whose evaluations in the VT clinic resulted in the diagnosis of normal binocular vision (NBV), according to the CIRS criteria. These criteria are:

1. near phoria between 2  $\Delta$  esophoria and 8  $\Delta$  exophoria;
2. near negative fusional vergence values greater than 9/17/8  $\Delta$  BI;
3. near positive fusional vergence greater than 12/15/4  $\Delta$  BO;
4. negative relative accommodation greater than +1.50 diopters (D);
5. positive relative accommodation greater than -1.25 D;
6. NPC less than 7.5cm.

Group 3 consisted of those subjects who did not fit the criteria of groups 1 or 2. They were not diagnosed as CI but their data was used for totals in the analysis of the overall prevalence of CI at NSUOCO. Group 3 data underwent no further analysis. The study met the requirements of the NSU's Institutional Review Board (IRB).

The COVD-QOL contains 30 symptoms that impact one's daily comfort and performance. Each symptom is rated by the patient and/or parent according to the frequency the symptom is experienced. Symptom ratings are: never, seldom, occasionally, frequently, or always. See Ap-

Symptoms	CI Mean	CI Std. Dev	NBV Mean	NBV Std. Dev	Significance
1	2.20	1.476	0.91	0.944	0.026 **
2	1.30	1.418	0.82	1.079	0.389
3	1.70	1.636	0.91	1.300	0.233
4	0.78	1.394	1.09	0.944	0.558
5	1.60	1.075	1.18	1.250	0.424
6	0.60	1.075	0.45	0.820	0.730
7	1.00	1.247	0.64	1.286	0.519
8	1.80	1.229	1.55	1.036	0.613
9	0.80	1.033	0.45	0.820	0.404
10	1.80	1.619	0.18	0.603	0.012 **
11	1.70	1.337	1.27	1.421	0.488
12	1.90	1.449	0.82	1.079	0.066 •
13	1.80	1.619	1.18	1.168	0.325
14	2.00	1.491	0.91	0.944	0.057 •
15	1.30	1.252	1.00	1.000	0.549
16	1.30	1.567	1.73	1.272	0.499
17	0.80	1.229	1.27	1.489	0.440
18	1.40	1.265	1.00	1.000	0.429
19	2.00	1.826	1.73	1.348	0.699
20	1.60	1.350	1.82	1.537	0.735
21	1.80	1.549	2.09	1.446	0.661
22	0.70	1.160	1.27	1.348	0.312
23	1.60	1.647	0.91	0.944	0.247
24	1.70	1.418	1.09	0.831	0.239
25	1.30	1.494	1.55	1.293	0.691
26	1.90	1.287	1.73	1.421	0.774
27	1.50	1.509	1.64	1.567	0.842
28	1.80	1.033	1.73	1.555	0.902
29	1.10	0.944	0.82	1.168	0.561
30	1.50	1.434	1.63	1.302	0.851

••= significant to 0.05 confidence level, • = significant to 0.07 confidence level

pendix A. The COVD-QOL represents a global survey of not only nearpoint issues, but also distance issues. Participants included in groups one and two were required to have a completed COVD-QOL on file. Group 3 records underwent no further analysis.

The level of reliability, validity and appropriateness of the COVD-QOL have been investigated. Reliability here refers to the test-retest repeatability of the survey,<sup>23,24</sup> while validity refers to the ability of the survey to adequately address a desired issue.<sup>17, 27,28</sup> Each symptom on the COVD-QOL was analyzed for its prevalence and severity in groups 1 and 2. The data was statistically evaluated by a student t-test.

## RESULTS

The results yielded a 7.75% (10 of 129 records) prevalence of CI in the NSUOCO

VT Clinic. The means of 21 of the 30 symptoms were higher for the CI group (See Table 1.) when compared to the NBV group. CI subjects had significantly higher scores,  $p < 0.05$ , in two symptoms: item 1-*Blurred vision at near*; and item 10-*Head tilt or close eye when reading*. Scores that approached significance were item 12-*Avoidance of reading and near work*  $p=0.06$ , and item 14-*Writing uphill or downhill*  $p=0.057$ . See Table 1. Item 10 represents the largest (10-fold) difference in means between the two groups; the CI group rated this item an average of 1.80 versus the NBV group of 0.18. Figure 1 graphically depicts the means for each of the COVD-QOL symptoms.

## DISCUSSION

This retrospective chart review was performed to ascertain whether subjects diagnosed with CI could be separated

## Symptoms of Convergence Insufficiency (CI) Subjects to Normal Binocular Vision (NBV) Subjects

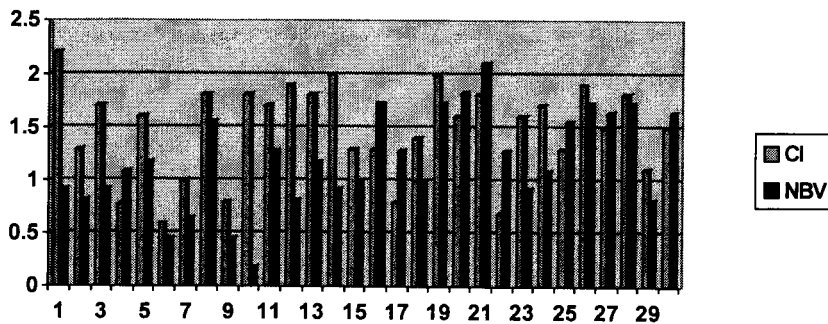


Figure 1. Symptom means of CI and NBV subjects of the COVD-QOL checklist.

from subjects with NBV on the basis of COVD-QOL scores. Patients, upon arrival at the NSUOCO VT Clinic, routinely complete this checklist.

The COVD-QOL is divided into four categories, which represent the global nature of the survey. These categories include: physical/occupational, psychological, social interaction, and somatic sensations.<sup>22</sup> Two of the 30 items listed in the COVD-QOL were statistically significant at the 0.05 level of confidence, and two approached this level when subjects with CI when compared to those with NBV.

The CIRS had designed a questionnaire with 15 items identified as being specific for CI.<sup>26</sup> See Appendix B. Maples has compared the COVD-QOL and the CIRS survey.<sup>23</sup> He concluded that there are more similarities between the two checklists than there are differences, but that the COVD-QOL is more comprehensive. A future study could compare the sensitivity and specificity of each of these two questionnaires for identifying patients with CI.

Our retrospective study indicates that there is a positive relation between the presence of nearpoint symptoms, specifically *blurred vision at near, head tilt or close eye when reading, avoidance of reading and near work, and writing uphill or downhill*, in individuals with CI. Furthermore, our study did not show that a definite discrimination between the two groups (CI and NBV) can be made using the COVD-QOL, except for the relationships found in the four symptoms previ-

ously discussed. However, it must be kept in mind that the checklist was designed to indicate QOL factors for conditions other than CI. QOL factors are very important in determining the therapy program to be instituted in treating a particular visual disorder; and can therefore greatly influence the outcome of therapy. It is for this very reason that such factors be evaluated and quantified, as they portray how a binocular anomaly impacts an individual's visual and social performance.

Other symptoms listed in the COVD-QOL were not significantly higher in the CI group than the NBV group; yet it is possible that an individual with CI certainly could experience them. These symptoms may, however, be more interrelated with other co-existing visual dysfunctions.

As with any study, confounding variables and limitations may introduce potential sources of error. In the present study one such source is that patients examined in the VT clinic were referred from satellite units throughout the NSUOCO clinical system. Thus, all patients had suspected or previously diagnosed binocular dysfunctions and were consequently a biased sample.

Furthermore, unlike the CIRS, which is administered by a clinician to the parent and child, different clinicians presented the COVD-QOL variably in our study. The parent may have been asked to complete the checklist at one instance, while both the parent and child were encouraged to work together in completing the form at another. This limitation has proven to be a

confounding factor when using the COVD-QOL as an indicator for measuring success in VT.<sup>17</sup>

Finally, although 21 of the 30 items were scored higher in the CI group as opposed to the NBV group, the fact that there was only a total of 21 subjects in the study is a very limiting factor. Consequently, the present data should be viewed as a pilot study and an impetus for further research that should address the previously described limitations.

## CONCLUSIONS

From the results of this pilot study: there is evidence of a 7.75% prevalence of CI at the NSUOCO VT clinic, a figure which is in agreement with previous reports of the condition in a clinical setting;<sup>1-4</sup> two of the 30 COVD-QOL items are higher for CI than they are for NBV at a statistically significant level; and two of the COVD-QOL items closely approached significance in the same manner. A larger sample may reveal more of the COVD-QOL items to be significant predictors of CI. Any similar study should control for COVD-QOL items that are related to other oculomotor, binocular, accommodative and perceptual deficits. The COVD-QOL may have significant potential in differentially screening for visual problems.

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### APPENDIX A. COVD-QOL

Name \_\_\_\_\_ Date \_\_\_\_\_

Please assign a value between 0 and 4 for each symptom

0 = never or nonexistent; 1 = seldom; 2= occasionally; 3 = frequently; 4 = always

Item	Category	Symptom	
1	S	Blurred vision at near	_____
2	S	Double vision	_____
3	S	Headaches associated with near work	_____
4	S	Words run together when reading	_____
5	S	Burning, stinging, watery eyes	_____
6	S	Falling asleep when reading	_____
7	S	Vision worse at the end of the day	_____
8	PO	Skipping or repeating lines when reading	_____
9	S	Dizziness or nausea associated with near work	_____
10	PO	Head tilt or close eye when reading	_____
11	PO	Difficulty copying from the chalkboard	_____
12	PO	Avoidance of reading and near work	_____
13	PO	Omitting small words when reading	_____
14	PO	Writing uphill or downhill	_____
15	PO	Misaligning digits in columns of numbers	_____
16	PO	Reading comprehension declining over time	_____
17	SI	Inconsistent/ poor in sports performance	_____
18	PO	Holding reading material too close	_____
19	P	Short attention span	_____
20	SI	Difficulty completing assignment in reasonable time	_____
21	P	Saying "I can't" before trying	_____
22	SI	Avoiding sports and games	_____
23	PO	Difficulty with hand tools, scissors, screwdriver, calculator, keys	_____
24	PO	Inability to estimate distance accurately	_____
25	PO	Tendency to knock things over on desk or table	_____
26	SI	Difficulty with time management	_____
27	SI	Difficulty with money concepts, making change	_____
28	P	Misplaces or loses papers, objects, belongings	_____
29	S	Car sickness/ motion sickness	_____
30	P	Forgetful, poor memory	_____

S, somatic sensation;  
 PO, physical/occupational;  
 SI, social interaction; and  
 P, psychological well being.

**APPENDIX B. CIRS Symptom Questionnaire (parent version)**

Symptom	Never	Sometimes	Often	Very Often
1. Has your child reported that his/her eyes feel tired or uncomfortable when reading or studying?				
2. Has your child reported having headaches when reading or studying?				
3. Has your child reported feeling sleepy when reading or studying?				
4. Have you noticed your child losing his/her concentration when reading or studying?				
5. Have you noticed your child having trouble remembering what he/she has read?				
6. Has your child reported double vision when reading or studying?				
7. Has your child reported seeing the words move, jump, swim, or appear to float on the page when reading or studying?				
8. Do you feel your child reads slowly?				
9. Has your child reported that his/her eyes ever hurt or feel sore when reading or studying?				
10. Has your child reported a "pulling" feeling around his/her eyes when reading or studying?				
11. Has your child reported words blurring or coming in and out of focus when reading or studying?				
12. Have you seen or has your child reported losing his/her place while reading or studying?				
13. Have you seen or has your child reported having to re-read the same line of words when reading?				
14. Does your child avoid reading?				
15. Do you feel your child has a short attention span when reading or studying?				