The VF-14 and Psychological Impact of Amblyopia and Strabismus

Kourosh Sabri,1 Christopher M. Knapp,2 John R. Thompson,3 and Irene Gottlob2

PURPOSE. To assess the impact of amblyopia, strabismus and glasses on subjective visual and psychological function among amblyopes.

METHODS. Questionnaires were administered to 120 teenagers with amblyopia (cases), with residual amblyopia after treatment, or with or without strabismus and 120 control subjects (controls) Cases underwent ophthalmic examination including cycloplegic refraction. Two questionnaires (visual function 14 [VF-14] and a newly designed eight-item questionnaire) were administered to assess the psychological impact score of general daily life, having a weaker eye, glasses wear, and current noticeable strabismus. Questionnaires were validated in 60 subjects in each group by a second administration of the questionnaire. The VF-14 scores, psychological impact scores, and clinical data were compared.

RESULTS. The VF-14 and psychological impact scores were highly reproducible. The mean VF-14 score for the control group was 95.5 and for the cases was 78.9 (P < 0.0001), but the scores did not correlate with the severity of amblyopia. The psychological impact score in general daily life was sensitive in discriminating between mild (median score 31) and moderate to severe (median score 56) amblyopes (P < 0.02). The cases segregated into two clear groups; those who scored high (large detrimental psychological impact) on psychological impact, with subjectively noticeable manifest strabismus, and those who scored low (low detrimental psychological impact), without noticeable strabismus. The subjective experience of patching treatment differentiated the two groups best of all.

CONCLUSIONS. Subjective visual and psychological functions are altered compared with normal subjects due to amblyopia, strabismus, and a previous unpleasant patching experience. The mean VF-14 score was similar to that previously published for patients with glaucoma. The study underlines that amblyopia and/or strabismus have an impact on teenagers' subjective visual function and well-being. (Invest Ophthalmol Vis Sci. 2006;47:4386–4392) DOI:10.1167/iovs.05-1365

Amblyopia is a visual impairment due to the interruption of normal visual development. The prevalence is reported to range from 1% to 6.1%1–5 depending on the age group studied and the visual acuity criteria used. Amblyopia is an important cause of monocular vision loss in the 20- to 70-year-old age group,4 and patients are at risk of losing vision in the healthy eye.5,6 Because amblyopia affects vision unilaterally in most children, the need for screening programs and treatment with patching has been questioned.3 Quality-of-life measurements obtained with questionnaires have become an increasingly important tool for assessment of patients' physical, functional, and psychological well-being. There has been much interest regarding quality-of-life in relation to vision,7 and questionnaires have been developed to assess visual function and psychosocial status in various eye diseases.8–12 The visual function-14 (VF-14) questionnaire, which contains questions regarding 14 vision-dependent activities was first developed for use in patients with cataract.13 Since then, it has been used with several other chronic eye diseases.14,15 Searching the MedLine and PsycINFO databases (1994 onward, when the VF-14 was developed13), we did not find publications using the VF-14 for amblyopia or any other strictly uniocular conditions.

Several studies have assessed the impact of amblyopia on quality-of-life.12,16 However, these studies involved new questionnaires that were not validated by an initial reproducibility study. Furthermore, in one such study,12 the number of subjects was small, and the questions did not fully address the complex nature of amblyopia, as only nonstrabismic amblyopes were included. Van de Graaf et al.16 combined patients treated for amblyopia as well as strabismus in their analysis. Horwood et al.17 found that children wearing glasses or with a history of wearing eye patches were more likely to be victims of physical or verbal bullying.

Morbidity due to amblyopia and strabismus may be visual, involving inability to performed vision-related activities; emotional, involving social interactions, and perceptions; or a combination of both. The etiology (e.g., strabismus), treatment (e.g., patching, glasses), and resultant reduced vision may all contribute to the morbidity.

Our objective was to assess the visual and psychological impact of amblyopia, strabismus, wearing glasses, and having previous patching in teenagers by using the VF-14 questionnaire and a newly designed psychological impact questionnaire.

METHODS

This study had the full approval of the Leicestershire Ethics Committee and adhered to the tenets of the Declaration of Helsinki. Enrollment was entirely voluntary, and before the study, written informed consent was obtained from both the participating children and their parents or guardians. There was no financial or other form of incentive for the subjects to participate in the study.

Questionnaire Design

The questionnaire consisted of the following sections: (1) personal details including age, gender and ethnicity, (2) the VF-14, (3) psychological impact, (4) the subjective experience of patching, and (5) the subjective presence of noticeable strabismus. The latter two sections applied to the cases only.
VF-14 Questionnaire

The original VF-14 questionnaire was used. Each question is scored on a scale of 0 (unable to perform an activity at all) to four (able to engage in activity fully). The average score is multiplied by 25 to give an overall score ranging from 0 to 100. For VF-14 the scores are given in points. Zero implies inability to do any of the activities, whereas a score of 100 denotes ability to perform all activities without any difficulty.

Psychological Impact Questionnaire

After a review of the literature and discussion groups involving the authors and 20 amblyopic teenagers aged 16 to 18 years, the psychological impact questionnaire was designed (Fig. 1). Because we were interested whether amblyopia without noticeable strabismus was influencing the well-being of the subjects, we also added specific questions concerning visual function (questions 7 and 8). The amblyopic teenagers gave valuable input regarding the key areas that the questionnaire should cover. The purpose was to assess the psychological impact in general daily life, specifically due to wearing glasses, having a weaker eye, and having a noticeable strabismus. This goal was achieved by asking the same eight questions (Fig 1) in relation to each of the four factors mentioned. Each question was answered “rarely,” “occasionally,” “sometimes,” “mostly,” or “almost always” and scored from 0 to 4 respectively. For each subject, the average score was multiplied by 25 to give a psychological impact score (PIS) ranging from 0 to 100. As for the VF-14, the scores for the PIS are given in points. A score of 0 implies no detrimental psychological impact, and a score of 100 implies a maximum detrimental psychological impact.

All cases were asked “how did you find the experience of patching?” to which they could respond by answering “unpleasant,” “acceptable,” or “cannot remember.” Furthermore, all patients with manifest strabismus were asked whether in their opinion they currently had a cosmetically noticeable strabismus.

Subjects

Cases with residual amblyopia who had been treated for amblyopia at the Leicester Royal Infirmary eye department were sequentially selected from an existing database. Of 145 cases contacted, 120 participated in the study. Only children with amblyopia, strabismus, or refractive error, best corrected visual acuity (VA), and any manifest strabismus were included (Table 1). Questionnaires were completed at home and returned by mail.

Controls with normal vision in each eye were recruited from students attending two colleges in the city of Leicester, United Kingdom. All entrants were between 16 and 18 years of age at the time of enrollment. One hundred and one (84%) controls were in high school and 19 (16%) were in apprenticeship at the time of enrollment. Controls were excluded if there was any previous history of ocular disease, surgery, amblyopia treatment, or any other current health problems. All controls had their best corrected distance Snellen visual acuity measured at school by one of the authors (KS). A minimum corrected distance visual acuity of 6/6 in each eye was required for inclusion in the control group. Questionnaires were completed at home and collected at the next visit in the classrooms. The age, gender, and ethnic distribution of the cases and controls were similar (Table 1).

Study Design and Statistical Methods

The first 60 cases and 60 controls who were enrolled in the study completed the questionnaire twice, with the second completion of the questionnaire being 2 to 4 weeks after the first completion. These responses were used to assess the reproducibility of the questionnaire. The first questionnaires completed by the subjects in the reproducibility study were used for the main study. In addition a further 60 cases and 60 controls were recruited and completed the questionnaire only once.

The method of Bland and Altman was used to assess reproducibility. This involves plotting the difference between the first and second measurements against the average of the two measurements and the calculation of the mean and SD of the differences. The data calculated as the mean difference ± 1.96 times its SD are known as the 95% limits of agreement. Cases and controls were compared with the nonparametric Wilcoxon rank sum test.
Nonparametric Wilcoxon rank sum tests were used for the remaining statistical analyses and adjusted for multiple comparison using the Bonferroni method.

RESULTS

Reproducibility based on samples of 60 subjects gives an 87% power to detect a small systematic average difference between first and second measurements of 0.4 in psychological impact factor, assuming an SD of 1 and the same power to detect a bias of 0.8 if the SD is 2. Total samples of 120 cases and 120 controls give a 97% power to detect a psychological impact factor difference of 5 units, assuming a 10-unit SD in each group. Under the same assumptions, there would still be an 80% power to detect a difference of 5 units between two subgroups of 60 patients.

All analyses of results are based on the first response of the initial 60 cases and controls who completed the questionnaire twice. The mean VF-14 score or psychological impact score is respectively plotted against the difference in the scores between the two sets of answers per respondent. The Bland-Altman analysis of the repeat measurements for the VF-14 scores is shown in Figure 2A and indicates good agreement. The 95% limits of agreement were ±2.6 for the cases and ±2.4 for the controls. This represents a ±3% error in the average VF-14 score of 88 across the two groups.

Reproducibility

Figures 2A and 2B refer to the initial 60 cases and controls who completed the questionnaire twice. The mean VF-14 score or psychological impact score is respectively plotted against the difference in the scores between the two sets of answers per respondent. The Bland-Altman analysis of the repeat measurements for the VF-14 scores is shown in Figure 2A and indicates good agreement. The 95% limits of agreement were ±2.6 for the cases and ±2.4 for the controls. This represents a ±3% error in the average VF-14 score of 88 across the two groups.

Table 1. Characteristics of the Subjects

<table>
<thead>
<tr>
<th></th>
<th>Reproducibility Study</th>
<th>Full Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases (n = 60)</td>
<td>Controls (n = 60)</td>
</tr>
<tr>
<td>Male gender</td>
<td>25 (42%)</td>
<td>25 (42%)</td>
</tr>
<tr>
<td>Mean age in years (SD)</td>
<td>16.7 (1.1)</td>
<td>16.2 (1.1)</td>
</tr>
<tr>
<td>White</td>
<td>28 (47%)</td>
<td>28 (47%)</td>
</tr>
<tr>
<td>Asian*</td>
<td>20 (33%)</td>
<td>20 (33%)</td>
</tr>
<tr>
<td>Currently wearing glasses</td>
<td>80 (67%)</td>
<td>26 (22%)</td>
</tr>
<tr>
<td>Anisometropic amblyopia</td>
<td>25 (42%)</td>
<td>N/A†</td>
</tr>
<tr>
<td>Strabismic amblyopia</td>
<td>20 (33%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Mixed amblyopia</td>
<td>15 (25%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Current strabismus‡</td>
<td>10 (17%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Age range in years at termination of amblyopia treatment (mean)</td>
<td>6.9–8.2 (7.2)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* Parents from India, Pakistan, Bangladesh or Sri Lanka.
† Manifest strabismus >10 prism diopters.
‡ Not applicable.

Table 2. Best Corrected Visual Acuity in Cases and Controls of Worse Eyes Compared with Better Eyes

<table>
<thead>
<tr>
<th>VA Worse Eye</th>
<th>VA Better Eye</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6/5</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
</tr>
<tr>
<td>6/5</td>
<td>41</td>
</tr>
<tr>
<td>6/6</td>
<td>39</td>
</tr>
<tr>
<td>Cases</td>
<td></td>
</tr>
<tr>
<td>6/9</td>
<td>55</td>
</tr>
<tr>
<td>6/12</td>
<td>18</td>
</tr>
<tr>
<td>6/18</td>
<td>5</td>
</tr>
<tr>
<td>6/24</td>
<td>3</td>
</tr>
<tr>
<td>6/36</td>
<td>1</td>
</tr>
</tbody>
</table>

Cases and controls, n = 120 each.

Figure 2A. Bland-Altman plot showing the reproducibility of the (A) VF-14 score and (B) PIS in general daily life. Horizontal lines: means and 95% limits of agreement. (○) Controls; (●) cases.

Downloaded From: http://iovs.arvojournals.org/pdfaccess.ashx?url=data/journals/iovs/932935/ on 06/04/2018
VF-14 Scores

All the following results refer to the analysis of the 120 controls and 120 cases who completed the VF-14 questionnaire. Table 3 shows the mean and range of VF-14 scores for all controls and subgroups with and without glasses and with and without strabismus. The mean VF-14 score for the control group was 95.5 (range, 86.4–100) and for the cases, 78.9 (range, 61.4–93.2). This difference was significant ($P < 0.001$). Figure 3A shows the relationship between the VF-14 score and VA in the worse eye in both cases and control. There was only a weak correlation between the VF-14 score and VA in the worse eye within the amblyopic group ($r = 0.42, P < 0.001$). For the VF-14 score, there was no significant difference between wearing glasses and not wearing glasses for either controls or cases and no significant difference between cases with or without strabismus.

Psychological Impact Score in General Daily Life

Table 3 shows the mean and range of psychological impact scores for the control group, for the cases and for the cases with or without glasses and with or without strabismus. A high score means that the issue had more of a negative impact on the individual. The mean psychological impact score regarding the general daily life question was 18.2 (range, 6.3–33.3) for the individual. The mean psychological impact score regarding the general daily life question was 18.2 (range, 6.3–33.3) for the cases and 37.2 (range, 20.8–65.6) for the cases. The difference in psychological impact score was significant ($P < 0.001$). Thus, for example, only five controls (4.2%) avoided going out with friends sometimes or more often compared with 40 (33.3%) of cases, whereas 71 controls (59.2%) worried about losing their eyesight only rarely compared with 20 (16.7%) of the cases. There was no significant difference between the controls and cases in psychological impact scores, whether they wore glasses or not (Table 3).

Table 3. Overview of the Results for the VF-14 Score and Psychological Impact Score Due to General Daily Life

<table>
<thead>
<tr>
<th></th>
<th>VF-14 Score</th>
<th>Psychological Impact Score on General Daily Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controls ($n = 120$)</td>
<td>Cases ($n = 120$)</td>
</tr>
<tr>
<td></td>
<td>Mean Range</td>
<td>Mean Range</td>
</tr>
<tr>
<td>All subjects</td>
<td>95.5 86.4–100</td>
<td>78.9* 61.4–93.2</td>
</tr>
<tr>
<td>With glasses</td>
<td>93.5 86.4–100</td>
<td>77.6 61.4–91.2</td>
</tr>
<tr>
<td>Without glasses</td>
<td>96.2 88.5–100</td>
<td>80.2 64.2–95.2</td>
</tr>
<tr>
<td>No strabismus</td>
<td>N/A† N/A</td>
<td>79.6 63–93.2</td>
</tr>
<tr>
<td>Noticeable strabismus</td>
<td>N/A N/A</td>
<td>78 61.4–91.2</td>
</tr>
<tr>
<td>No noticeable strabismus</td>
<td>N/A N/A</td>
<td>78.2 61.4–91.5</td>
</tr>
</tbody>
</table>

* Significant difference between controls and cases ($P < 0.001$).
† Significant difference between cases with noticeable strabismus and cases with no strabismus ($P < 0.05$).
VF-14 score for all cases and controls. The data were represented twice to show the influence of the subjective experience of patching and of current noticeable strabismus. In Figure 4A, the cases are subdivided according to their reported experience of patching treatment. If the cases are taken as a whole (all filled symbols), there is only a weak correlation between the psychological impact score due to general daily life and the VF-14 score among the cases (r = -0.34; P = 0.002). The psychological impact score for the cases shows a bimodal distribution; one group with a higher psychological impact score of ∼60 and the other with a lower psychological impact score of ∼25. All but two of the cases who reported patching to have been an acceptable experience had a low psychological impact score (median psychological impact factor of 26), whereas those who reported patching to have been an unpleasant experience all had a high psychological impact score (median psychological impact factor of 56). This difference was significant (P < 0.0001). All the cases could remember whether the patching experience was acceptable or not (no subject answered “cannot remember”).

Among the 120 cases, 18 had a current manifest strabismus >10 prism diopters, 47 had a current manifest strabismus ≤10 prism diopters, and 55 cases had never had strabismus. When asked whether in their opinion they had a current noticeable strabismus, 19 cases answered yes. This included the 18 cases with a current manifest strabismus >10 prism diopters and 1 with a manifest strabismus of eight prism diopters. Therefore, there was a high degree of correlation between the subjective opinion of a current strabismus and objective manifest deviations of >10 prism diopters. In Figure 4B the cases are divided into three groups: 19 who thought they had strabismus currently (18 with current strabismus >10 prism diopters plus one with strabismus of 8 prism diopters), 46 who thought they had had strabismus (all with current strabismus ≤10 prism diopters), and the 55 who had never had strabismus. The cases who had never had strabismus (filled circles) have a low overall psychological impact score (range, 20.8 – 41; mean 28.4), similar to the controls. Those who thought they had had strabismus (filled triangles) are divided between the two aforementioned groups for their overall psychological impact scores.

**Psychological Impact Score for Wearing Glasses, Having a Weaker Eye, and Having Noticeable Strabismus**

Among the cases, there were no differences between psychological impact scores for wearing glasses, having a weaker eye, and having noticeable strabismus and the psychological impact scores in general daily life. Therefore, we present here some examples only. Because of having a weaker eye, 9% of amblyopes were teased mostly or always, 12% worried about losing eyesight mostly or almost always, 21% avoided outdoor activities sometimes or more often, and 41% became depressed sometimes or more often. There was no clear correlation between the psychological impact scores due to noticeable strabismus and the VF-14 score or the angle of the manifest strabismus. Six (32%) of 19 cases were teased sometimes or more often, 7 (37%) became depressed sometimes or more often, and 9 (47%) avoided outdoor activities sometimes or more often—all attributable by the subject to having cosmetically noticeable strabismus.

**DISCUSSION**

The 16- to 18-year age group was chosen for several reasons. The entrants were old enough to answer the questionnaires and yet the amblyopes were young enough not only to have remained within the vicinity of the city of Leicester (thereby maximizing recruitment), but also to remember their experience with patching treatment. In addition, the well-being and self-esteem of teenagers has long-lasting influence on their future development. A longitudinal study of more than 6000 children aged 13 to 15 years in Australia as well as a study of over 1000 subjects aged 16 to 25 years in France, have shown that low self-esteem in childhood is a significant risk factor for depression and suicide attempts in later life.

In our study, the response rate was high; however, we cannot completely exclude a potential bias caused by the 18% unreturned questionnaires. We have shown that the VF-14 questionnaire is sensitive in discriminating between the amblyopes and controls. The VF-14 questionnaire was originally designed for use in patients with cataracts. Steinberg et al. investigated patients with cataract who had worse eye VA ranging from 20/20 to NPL and better eye VA ranging from 20/20 to hand motion. Of interest, they found that the VF-14 scores of the cataract patients correlated better with their perceived trouble due to poor vision than did either better eye VA or worse eye VA. To this end, the results of Steinberg et al. support our findings of a lack of significant correlation between the VF-14 score and the worse eye VA among the amblyopes. The mean VF-14 score of all cases was 78.9. This is similar to the scores found in patients with glaucoma and ranks between the VF-14 scores found in patients with longstanding exudative age-related maculopathy and patients who have undergone penetrating keratoplasty for keratoconus. The VF-14 has been used in children with nystag-
and has shown good correlation with the same questions asked to parents about their children’s vision. It has not been compared with the actual visual acuity of the children.

More recently, van de Graaf et al.\textsuperscript{46} have devised a questionnaire to assess visual function and quality of life in adult amblyopes. They looked at five domains: fear of losing the better eye, estimation of the distance of objects, visual disorientation, diplopia, and problems with social interaction. Amblyopes were found to perceive more problems than the controls in all five domains. However, van de Graaf et al.\textsuperscript{46} did not distinguish between amblyopia, strabismus, and wearing glasses in their analysis. Furthermore, they looked at an older age group with a wider age range, and their questionnaire had not been assessed for reproducibility.

Our newly designed psychological impact questionnaire in general daily life was sensitive in discriminating among cases, controls, and those with significant amblyopia (worse eye VA ≤6/18). Within the amblyopic cohort, we found two subgroups: one with higher psychological impact scores and the other with lower psychological impact scores. A tropia of 10 prism diopters or more was strongly associated with subjectively noticeable strabismus (indicated in the questionnaire) and a high general daily life psychological impact score. The critical angle for noticing manifest strabismus was >10 prism diopters in all but one case. Our results, therefore, support the concept that manifest strabismus can cause significant psychological problems in teenagers. Satterfield et al.\textsuperscript{18} investigated 43 strabismic amblyopes (aged 15–81 years) with a current manifest strabismus >11 prism diopters. They found perceived strabismus to interfere with work, play, or sporting activities in 84% and 85% of cases during the teenage and adult years, respectively. Furthermore, strabismus was attributed for poor self image in 72% of cases during the teenage years and in 77% of cases in adulthood. Using the Hopkins Symptoms Checklist\textsuperscript{25} (a 58-item psychological self-report inventory), Satterfield et al.\textsuperscript{18} found their strabismic patients to score significantly worse than the controls (P < 0.01). Furthermore, as the cohort was much older, questions referring to childhood would depend heavily on the powers of recollection of the cases. In our study, an unpleasant patching experience was strongly associated with a high psychological impact score. Because subjects with an unpleasant patching experience were largely the same as those with noticeable strabismus (Fig. 4), one possible hypothesis is that the subjects with an unpleasant patching experience had the worse amblyopia and binocular potential and therefore developed consecutive strabismus, which made them more self-conscious of their appearance.

In a psychological assessment of over 5000 children in the United Kingdom aged 8.5 years, Horwood et al.\textsuperscript{17} found that those wearing glasses or with previous patching were 35% to 37% more likely to be victims of physical and verbal bullying. Whereas we found that unpleasant patching experience influenced the psychological impact score of teenagers, our questionnaire did not show a significant difference in controls or cases, whether they wore glasses or not. Differences between the studies could be either attributed to the different forms of assessing bullying, an in-depth interview compared with a short questionnaire which was not primarily directed at bullying or to the much larger number of subjects in the study by Horwood et al. or to the differences in the age groups assessed. Packwood et al.\textsuperscript{12} studied the psychological effects of amblyopia alone and administered a questionnaire survey to 25 treated amblyopes (age range, 15–64 years) with no previous history of strabismus. They found major lifestyle concerns including the fear of losing vision in the good eye (8% of cases) and the negative effects of amblyopia on self image (12% of cases). Amblyopia caused slight to moderate perceived problems with work (52% of cases) and sporting activities (40% of cases). Using the Hopkins Symptoms Checklist,\textsuperscript{25} Packwood et al. found their group of amblyopes to have a significantly greater degree of somatization, obsession-compulsion, interpersonal sensitivity, depression, and anxiety compared with the control groups (P < 0.001). In our study, we looked at the psychological impact of amblyopia alone with a much larger sample, using a new, reproducible questionnaire.

In summary, we found that the overall VF-14 scores are different between amblyopic and nonamblyopic teenagers, but answers are not related to the degree of amblyopia. The newly developed psychological impact score was reproducible. The total scores differentiated between mild and severe amblyopia, cases with subjectively noticeable strabismus or no strabismus and was worse in cases who had unpleasant experience during patching. Our study underlines that amblyopia and/or strabismus have an impact on teenagers’ subjective visual function and well-being.

References


