Abstract

Objective: To evaluate the effect of glaucoma on the mental health of primary open-angle glaucoma patients using Hospital Anxiety and Depression Scale (HADS). Materials and Methods: This was a hospital-based comparative study in which 180 glaucoma patients and controls 18 years and above who met the inclusion criteria were selected consecutively in the Eye Clinic of Federal Medical Centre, Owerri, Imo State, in 2017. Data were collected using a questionnaire and the HADS protocol. All the participants underwent comprehensive ocular examination, and glaucoma was graded using visual field perimetric indices and mean deviation. Results: The mean age for cases was 58.14 ± 13.38 years, whereas that of the control group was 57.19 ± 13.76 years. The majority of glaucoma respondents had the moderate form of the disease followed by the severe form. The glaucoma patients showed evidence of poor mental health with 59 (32.8%) of them anxious and 39 (21.7%) depressed compared to controls (P < 0.001). The mean scores for anxiety and depression were 6.02 ± 4.8 and 5.20 ± 4.5, respectively, for glaucoma patients, whereas those for the control group were 0.63 ± 1.8 and 0.64 ± 2.1, respectively (P < 0.001). There was no uniform correlation between the mental health of patients and the variables under study. Conclusion: Primary open-angle glaucoma affects the mental health of patients. This effect is worsened by the severity of the disease and influenced by the occupation and educational level of the patients. Multidisciplinary management of primary open-angle glaucoma patients is recommended.

Keywords: Glaucoma, impact, mental health

Introduction

Glaucoma is the leading cause of irreversible blindness globally.[1] Quigley and Broman in 2006, using prevalence models, reported a global glaucoma prevalence of 60.5 million in 2010 and 79.6 million in 2020.[2] By 2040, it is expected that approximately 111.8 million people will suffer from glaucoma.[3] In the United States of America, more than 3 million people are living with glaucoma, whereas 2.7 million people aged 40 years and above are affected by its most common form, open-angle glaucoma.[3] In Nigeria, the overall prevalence of blindness was 1.21% and the proportion of blindness due to glaucoma was 14.1% among those aged 40 years and above.[3] The glaucoma-specific blindness prevalence was 0.17%.[4] A recent study in Nigeria revealed that 5.02–6.9% (1.8 million) of people above 40 years suffer from glaucoma with almost 360,000 (20%) of them blind in both eyes.[3] Findings from various studies have shown that glaucoma is associated with low levels of psychosocial well-being characterized by a diminution in the individual’s perception of self and ability to function in the community and usually manifests as depression and/or anxiety.[5–10] Depressed people feel sad, empty, hopeless, worthless, and irritable with an aversion to activity.[11–13,14] Although anxiety is distinguished by feelings of preciosity and vulnerability, in severe cases, it comes with repeated apprehension and intense fear, which is incommensurate to the existing situation causing it.[11] It has been found that the presence of these symptoms in patients results in poor use of medication[15] and a vicious cycle of worsening vision.

About 90% of people who have glaucoma in the developing countries such as Nigeria are not aware that they have this disease.[16] This implies that many may develop severe visual impairment or blindness with its attendant psychological effects.

The Hospital Anxiety Depression Scale (HADS)[17–19] can aid in determining the psychosocial impact of glaucoma on patients, especially on their mental health. Evidence
elicited from the use of HADS may be utilized in the development of management strategies for glaucoma.

Materials and Methods

Study design

This was a hospital-based comparative study that comprised 180 old and new patients (18 years and above) diagnosed with varying degrees of severity of primary open-angle glaucoma and 180 age-matched, sex-matched controls with essentially normal eyes and no family history of glaucoma. Participants were selected consecutively until the sample size was attained.

Sample size determination

The sample size was estimated at 162 using the Charan and Biswas formula for case–control studies. To accommodate for non-response, an extra 10% was added to the sample size using the following formula: Calculated sample size multiplied by 100/100 − X, where X is 10 in this case.

The calculated minimum sample size was therefore 178. One hundred and eighty cases and 180 controls were recruited.

Eligibility criteria

Patients were considered eligible as cases if they had glaucomatous optic nerve head changes, glaucomatous visual field defect, and gonioscopically determined open anterior chamber angles, with or without elevated intraocular pressure (IOP) in both eyes. Patients must be on medical therapy only, and where early lens opacity was present, it had to be visually insignificant, and not prevent adequate visualization of the optic disc. Refractive error of not less than 5 dioptre sphere (DS) or 2 dioptre cylinder was accepted. The control group consisted of patients with non-glaucomatous optic nerve head, normal visual fields, gonioscopically determined open anterior chamber angles, normal IOP in both eyes, no family history of glaucoma, fully corrected refractive error less than 5 DS or less than 2 DCyl of astigmatism, and a best-corrected visual acuity of 6/9 or better. Cataract if present should be visually insignificant.

Exclusion criteria

Cases were excluded if they had primary angle-closure glaucoma, secondary glaucoma, and other causes of optic nerve abnormalities. Those already diagnosed with psychiatric disturbances and cognitive limitations such as dementia, hearing impairment, or systemic comorbidities such as diabetes mellitus, hypertension, and immunosuppression were also excluded.

In addition, participants were excluded as controls if they had suspicious disc (glaucoma suspects) or ocular hypertension (IOP > 21 mmHg).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki, and approval for the study was obtained from the Ethics Committee of Federal Medical Centre, Owerri, Imo State. A permission letter was also gotten from the Ophthalmology department. Written informed consent was obtained from each patient after proper explanation of the objectives of the study by signing or thumb printing.

Data collection

Data on the demographics, medical, and ophthalmic history of participants were obtained using a questionnaire. A comprehensive ocular examination comprising distance visual acuity assessment using Snellen chart, near visual acuity using Jaeger chart, Goldmann applanation tonometry, binocular dilated fundoscopy with +78 D lens, and gonioscopy using the 2-mirror Volk lens was done and recorded in a pro forma. Central visual field assessment using full threshold central 30-2 strategy (using Synemed EP-910) was used to grade glaucoma severity. Based on visual field perimetric indices and mean deviation (MD), glaucoma severity was grouped into mild, moderate, and severe glaucoma. Perimetric results were considered reliable if they had <30% false-positive and <30% false-negative errors, and <20% fixation losses. An MD representative of both eyes (MD OU) was calculated using a modification of the formula by Nelson-Quigg et al.

\[
MD\ OU = (MD\ RE^2 + MD\ LE^2)^{\frac{1}{2}}
\]

Mild (grade 1) is characterized by a nasal step or paracentral scotoma and MD less than −6 dB. Moderate (grade 2) is characterized by an arcuate scotoma and an MD −6 dB to −12 dB.

Severe (grade 3) is characterized by an extensive visual field loss including defects within the central 5° and MD more than −12 dB.

HADS consisting of 14 questions for assessment of mental health was administered by the researcher. Scores higher than 8 in both HADS-A and HADS-D were considered as anxiety and depression. The translated Igbo language version was administered to respondents who were not literate in English. Care was taken to reduce any bias that could occur because of translation.

Pilot test

A pilot test was done in Federal Medical Centre, Owerri, among 20 patients who were not included in the study to validate and test the reliability of the questionnaire.

Data analysis

Data were analysed using the Statistical Package for the Social Sciences version 21 software. It was subjected to descriptive statistics. Evaluation of group differences was done using the t-test and analysis of variance for continuous variables. Chi-square was used for analysis of categorical data. P-value ≤ 0.05 was considered statistically significant.

Results

A total of 360 patients were studied; 180 glaucoma patients and 180 non-glaucoma patients (control group). Thirty-one (8.6%) of the patients responded to the Igbo questionnaire.
Table 1: Socio demographic distribution of cases and controls

|                | Cases        | Controls     | Total    |
|----------------|--------------|--------------|----------|
| Age group (years) |              |              |          |
| <30            | 5 (2.8%)     | 8 (4.4%)     | 13 (3.6%)|
| 30–39          | 18 (10%)     | 14 (7.8%)    | 32 (8.9%)|
| 40–49          | 22 (12.2%)   | 26 (14.4%)   | 48 (26.7%)|
| 50–59          | 49 (27.2%)   | 50 (27.8%)   | 99 (27.5%)|
| 60–69          | 46 (25.6%)   | 49 (27.2%)   | 95 (26.4%)|
| 70+            | 40 (22.2%)   | 33 (18.3%)   | 73 (20.3%)|
| **Total**      | 180 (100.0%) | 180 (100.0%) | 360 (100.0%)|

\( \chi^2 = 15.703 \)

|                | df = 5       | \( P = 0.85 \) |

Gender

|          | Cases | Controls | Total |
|----------|-------|----------|-------|
| Male     | 66 (36.7%) | 66 (36.7%) | 132 (36.7%) |
| Female   | 114 (63.3%) | 114 (63.3%) | 228 (63.3%) |
| **Total** | 180 (100.0%) | 180 (100.0%) | 360 (100.0%) |

\( \chi^2 = 0.625 \)

|          | df = 1       | \( P = 1 \) |

Marital status

|      | Cases        | Controls     | Total    |
|------|--------------|--------------|----------|
| Single      | 24 (13.3%)   | 15 (8.3%)    | 39 (10.8%)|
| Married     | 121 (67.2%)  | 119 (66.1%)  | 240 (66.7%)|
| Separated   | 7 (3.9%)     | 4 (2.2%)     | 11 (3.1%) |
| Widowed     | 28 (15.6%)   | 42 (23.3%)   | 70 (19.4%)|
| **Total**   | 180 (100.0%) | 180 (100.0%) | 360 (100.0%) |

\( \chi^2 = 8.791 \)

|          | df = 3       | \( P = 0.032 \) |

---

Table 2: Proportion of respondents with anxiety (using HADS scores)

|                  | Cases | Controls | Total |
|------------------|-------|----------|-------|
| Anxiety          | 59    | 6        | 65    |
| Percentage       | 32.8  | 3.3      | 18.1  |
| Borderline       | 43    | 7        | 50    |
| Percentage       | 23.9  | 3.9      | 13.9  |
| Normal           | 78    | 167      | 245   |
| Percentage       | 43.3  | 92.8     | 68.0  |
| **Total**        | 180 (100.0%) | 180 (100.0%) | 360 (100.0%) |

Pearson chi-square = 53.896

\( P = 0.001 \)

HADS = Hospital Anxiety and Depression Scale

---

Table 3: Proportion of respondents with depression (using HADS scores)

|                  | Cases | Controls | Total |
|------------------|-------|----------|-------|
| Depression       | 39 (21.7%) | 2 (1.1%)  | 41 (11.4%) |
| Borderline       | 40 (22.2%) | 12 (6.7%) | 52 (14.4%) |
| Normal           | 101 (56.1%) | 166 (92.2%) | 267 (74.2%) |
| **Total**        | 180 (100.0%) | 180 (100.0%) | 360 (100.0%) |

Pearson chi-square = 28.048

\( P = 0.001 \)

HADS = Hospital Anxiety and Depression Scale

The difference in the age groups and gender distribution of the cases and control were not statistically significant (\( P = 0.85 \) and \( P = 1 \), respectively) [Table 1]. The difference in marital status between the two groups was statistically significant (\( P = 0.032 \)).

Fifty-nine (32.8%) glaucoma patients were anxious compared to six (3.3%) controls [Table 2]. This difference was statistically significant (\( P < 0.001 \)).

Thirty-nine (21.7%) glaucoma patients were depressed, whereas only two (1.1%) controls were depressed. The difference between the two groups was statistically significant (\( P < 0.001 \)) [Table 3].

The mean anxiety score for cases is 6.02 ± 4.816 and that for controls is 0.63 ± 1.837 [Table 4]. For depression, the mean score for cases is 5.20 ± 4.502, whereas for controls, it is 0.64 ± 2.113. The difference in the mean scores is statistically significant.
Table 5: Relationship between anxiety/depression and severity of glaucoma

| Glaucoma severity | No of anxious patients | No of depressed patients | Total | P-value |
|-------------------|------------------------|-------------------------|-------|---------|
| Mild (<−6 dB)     | 6 (10.2%)              | 4 (10.3%)               | 10    | <0.001 |
| Moderate (−6 dB to −12 dB) | 24 (40.7%)         | 10 (25.6%)             | 34    | <0.001 |
| Severe (≥−12 dB)  | 29 (49.2%)             | 25 (64.1%)             | 54    | <0.001 |
| Total             | 59 (100.0%)            | 39 (100.0%)            | 98    | <0.001 |

HADS-A = HADS anxiety, HADS-D = HADS depression

Table 6: The effect of sociodemographic variables on HADS scores for cases

| Variables            | HADS-A  | HADS-D  | T-value/F-ratio (HADS-A) (HADS-D) | P-value (HADS-A) (HADS-D) |
|----------------------|---------|---------|----------------------------------|--------------------------|
| Gender               |         |         |                                  |                          |
| Male                 | 7.8 (±5.0) | 6.7 (±5.0)   | (3.8)                           | (0.01) (A)               |
| Female               | 4.9 (±4.4) | 4.3 (±3.9)    | (3.3)                           | (0.383) (D)              |
| Age (years)          |         |         |                                  |                          |
| <30                  | 9.0 (±0.0) | 7.3 (±2.3)    | (2.4)                           | (0.041) (A)              |
| 30–39                | 3.7 (±4.9) | 3.9 (±5.5)    | (2.7)                           | (0.021) (D)              |
| 40–49                | 5.6 (±5.0) | 2.7 (±3.4)    | (4.4)                           | (0.002) (D)              |
| 50–59                | 5.0 (±3.9) | 4.8 (±3.5)    | (4.4)                           | (0.002) (D)              |
| 60–69                | 6.6 (±5.4) | 5.7 (±5.0)    | (4.4)                           | (0.002) (D)              |
| 70+                  | 7.6 (±4.5) | 6.58 (±4.4)   | (4.4)                           | (0.002) (D)              |
| Marital status       |         |         |                                  |                          |
| Single               | 6.7 (±5.6) | 6.9 (±6.0)    | (3.086)                         | (0.229) (A)              |
| Married              | 5.6 (±4.8) | 4.5 (±4.2)    | (1.453)                         | (0.229) (D)              |
| Separated            | 7.0 (±0.0) | 7.0 (±0.0)    | (1.6)                           | (0.058) (A)              |
| Widow                | 7.4 (±4.4) | 6.8 (±4.2)    | (1.6)                           | (0.058) (A)              |
| Formal education     |         |         |                                  |                          |
| None                 | 6.6 (±3.7) | 5.7 (±2.2)    | (2.5)                           | (0.058) (A)              |
| Primary              | 7.6 (±5.2) | 6.2 (±4.6)    | (1.6)                           | (0.058) (A)              |
| Secondary            | 6.8 (±5.2) | 5.9 (±4.9)    | (1.6)                           | (0.058) (A)              |
| Tertiary             | 5.0 (±4.5) | 4.4 (±4.5)    | (1.6)                           | (0.058) (A)              |
| Occupation           |         |         |                                  |                          |
| Professional         | 2.2 (±2.3) | 1.5 (±2.3)    | (5.4)                           | (<0.001) (A)             |
| Skilled              | 5.6 (±4.9) | 5.4 (±4.8)    | (4.4)                           | (0.002) (D)              |
| Unskilled            | 5.6 (±4.7) | 4.8 (±4.2)    | (4.4)                           | (0.002) (D)              |
| Student              | 8.3 (±1.6) | 6.5 (±1.9)    | (4.4)                           | (0.002) (D)              |
| Unemployed           | 8.1 (±5.0) | 6.8 (±4.8)    | (4.4)                           | (0.002) (D)              |

HADS = Hospital Anxiety and Depression Scale, HADS-A = HADS anxiety, HADS-D = HADS depression

Majority of the anxious patients had severe glaucoma followed by those who had moderate glaucoma [Table 5]. This pattern also occurred in patients who had depression. There was a statistically significant relationship between severity of glaucoma and anxiety, and depression.

The sociodemographic variables that may influence anxiety and depression scores were analysed using multivariate linear regression methods [Table 6]. Education and occupation significantly affected anxiety and depression scores of the patients.

Discussion

The glaucoma patients in the present study showed evidence of poor mental health with a significantly ($P < 0.001$) higher number anxious (32.8%) and depressed (21.7%) than the controls [Tables 2 and 3]. This finding implies that many individuals living with glaucoma also have comorbid psychological problems. The fearful possibility of blindness that is caused by this disorder may be the source of anxiety in these patients. Anxiety can result from patient’s fear of battling with lifelong management of the disease, threat
to losing one’s vision, and expensive and time-consuming use of medications. Those patients who have started losing their vision are likely to be depressed as a result of inability to do previous tasks, which hitherto, they were able to accomplish easily. This is similar to findings from previous studies. Sharma et al.\textsuperscript{[25]} observed that out of 100 eligible glaucoma cases, 44\% were anxious, whereas 35\% were depressed. Mabuchi et al.\textsuperscript{[26]} also found that the prevalence of primary open-angle glaucoma patients with anxiety (13.0\%) was significantly higher ($P = 0.030$) than that of controls (7.0\%) while the prevalence for depression at 10.9\% was also significantly higher ($P = 0.026$) in the cases. Similar evidence was also reported in other studies with varying prevalence.\textsuperscript{[27-31]} In contrast, Wilson et al.\textsuperscript{[12]} found no significant difference in depression scores between glaucoma patients and control groups. This may be attributed to the fact that majority of the respondents in Wilson et al.\textsuperscript{[21]} study were elderly and retired and so probably had little or no fear of job loss and its attendant economic implications.

The mean scores for anxiety and depression were 6.02±4.8 and 5.20±4.5 respectively for glaucoma patients while the control group had 0.63±1.8 and 0.64±2.1 respectively for both depression and anxiety [Table 4]. There was a statistically significant difference between these mean scores. Hwang et al.\textsuperscript{[31]} found a similar result of mean scores for cases. They had 6.5±4.1 for anxiety and 5.3±4.1 for depression but had higher mean scores for their control groups 4.8±3.8 for anxiety and 6.5±4.1 for depression. This difference maybe as a result of differences in methodology. While the present study excluded glaucoma suspects, and used equal numbers of cases and controls, their study included glaucoma suspects and had fewer number of participants as controls.

A comparison of HADS scores and severity of glaucoma revealed that respondents with severe glaucoma were more anxious and/or depressed [Table 5]. Mabuchi et al.\textsuperscript{[26]} found that increasing glaucoma severity was a risk factor for depression in patients with glaucoma. This was also corroborated by a Singapore study,[\textsuperscript{33}] which reported that one of the risk factors for depression and anxiety disorder is having a more severe form of the disease. It is therefore pertinent to note that just as psychosocial stress can translate into illness that will require treatment, some physical illnesses such as glaucoma can cause psychiatric disorders severe enough to require treatment by specialists.

This study revealed that males had higher depression and anxiety scores than females [Table 6]. Similarly, Dawodu et al.\textsuperscript{[27]} found all depressed patients in their study to be males even though the sample size was small. This is at variance with the report by Lim et al.\textsuperscript{[33]} and Eshun\textsuperscript{[34]} of higher depression and anxiety in females than male glaucoma patients. This difference could be due to differences in methodology including study location. Hwang et al.\textsuperscript{[31]} reported higher anxiety in males than females and more depression scores in females than males.

The HADSs compared with age ranges of the study sample revealed that the younger age group was more anxious and depressed (9.0±0.0 and 7.3±2.3, respectively) compared to the older age group [Table 6]. Other studies corroborate this finding.\textsuperscript{[27]} The severity of glaucoma and the deep-seated desire for the aging to retire peacefully without health challenges and physical handicap may result in psychological disorders, especially when faced with lifelong visual challenges.

Marital status was not significantly associated with anxiety and depression for glaucoma patients [Table 6].

Other studies also found no significant association between anxiety/depression and marital status of glaucoma patients.\textsuperscript{[25,31]} Occupation was significantly associated with anxiety ($P < 0.001$) and depression ($P = 0.002$). Similar results were found by other studies.\textsuperscript{[25]} This implies that the socioeconomic level of a patient is a very important factor to be considered while managing glaucoma patients. This is not surprising as the treatment of glaucoma is lifelong and basically expensive requiring a steady income for the patients to be able to purchase their drugs. This study found that a higher level of education was not significantly associated with anxiety ($P = 0.058$) and depression ($P = 0.192$) [Table 6]. Tertiary level of education had the least mean score for anxiety 5.0 ($±4.5$) and depression 4.4 ($±4.5$), whereas primary level of education had the highest mean score for anxiety 7.6 ($±5.2$) and depression 6.2 ($±4.6$). It is possible that with the higher level of education, the patients have a better understanding of the disease, present earlier, and follow through with their management processes. Lower level of education is usually associated with poorer income. This may be a source of worry for patients who have to source for funds for a lifelong treatment and also manage their family and social responsibilities.

**Conclusion**

Primary open-angle glaucoma patients experience some level of anxiety and depression. Variables such as age, gender, occupation, level of education, and severity of glaucoma have a significant effect on the mental health of patients.

**Recommendation**

A multidisciplinary approach is advocated for the management of glaucoma patients. Primary health physicians are usually the first port of call for glaucoma patients. They should be able to aid diagnosis and referral to ophthalmologists, interact with family members, and encourage family screening and psychotherapy for patients.

Patients may be encouraged to form and join support groups as this will help to alleviate the psychological burden of glaucoma.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.
References

1. Bassi CJ, Galanis JC. Binocular visual impairment in glaucoma. Ophthalmology 1991;98:1406-11.
2. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol 2006;90:262-7.
3. Allison K, Patel D, Alabi O. Epidemiology of glaucoma: The past, present, and predictions for the future. Cureus 2020;12:e11686.
4. Kyari F, Gudlavalleti MV, Sivsabramaniam S, Gilbert CE, Abdull MM, Entekume G et al.; Nigeria National Blindness and Visual Impairment Study Group. Prevalence of blindness and visual impairment in Nigeria: The national blindness and visual impairment study. Invest Ophthalmol Vis Sci 2009;50:2033-9.
5. Onakoya A. Every Nigerian is at risk of blindness from glaucoma; Available from: https://www.vanguardnrg.com. [Last accessed on 14 Mar 2017].
6. Kong XM, Zhu WQ, Hong JX, Sun XH. Is glaucoma comprehension associated with psychological disturbance and vision-related quality of life for patient with glaucoma? A cross-sectional study. BMJ Open 2014;4:e004632.
7. Tilahun MM, Yibekal BT, Kerebih H, Ayele FA. Prevalence of common mental disorders and associate factors among adults with Glaucoma attending University of Gondar comprehensive specialized hospital tertiary eye care and training center, Northwest, Ethiopia. Available from: https://doi.org/10.1371/journal.pone.0252064. [Last accessed on 20 May 2021].
8. Onwubiko SN, Nwachukwu NZ, Muomah RC, Okoloagu NM, Ngwegu OM, Nwachukwu DC. Factors associated with depression and anxiety among glaucoma patients in a tertiary hospital South-East Nigeria. Niger J Clin Pract 2020;23:315-21.
9. Huang W, Gao K, Liu Y, Liang M, Zhang X. The adverse impact of glaucoma on psychological function and daily physical activity. J Ophthalmol 2020;2020:9606420.
10. Holló G, Sándor NG, Kóthy P, Géczy A. Influence of painless one-eye blindness on depression, anxiety and quality of life in glaucoma patients with a normal fellow eye. BMC Ophthalmol 2021;21:89.
11. Raymond L. Psychosocial assessment: A nursing perspective; 2017. Available from: www.ceufast.com/courses/viewcourse. [Last accessed on 20 Oct 2017].
12. Nyman S, Gosney M, Victor C. The psychosocial impact of vision loss on older people. British Journal of Ophthalmology 2009;94:1427-31.
13. Cluebot N. Depression—WHO Department of Mental Health and Substance Abuse; 2012. Available from: en.wikipedia.org/wiki/depression- (mood). [Last accessed on 20 Oct 2014].
14. WHO. Depression; 2012. Available from: www.euro.who.int/en/ health-topics/depression/European Health Information Initiative. [Last accessed on 20 Oct 2014].
15. Jayant BS, Bhosle M, Anderson R, Balkrishnan R. Depressive symptomatology, medication, persistence, and associated health care cost in older adults with glaucoma. J Glaucoma 2007;16:513-20.
16. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis. Ophthalmology 2014;121:2081-90.
17. Abiodun OA. A validity study of the Hospital Anxiety and Depression Scale in general hospital units and a community sample in Nigeria. Br J Psychiatry 1994;165:669-72.
18. Severn P, Fraser S, Finch T, May C. Which quality of life score is best for glaucoma patients and why? BMC Ophthalmol 2008;8:2.
19. Arnstein M, Eystein S, Alva A. Hospital Anxiety and Depression (HAD) scale: Factor structure, item analyses and internal consistency in a large population. Br J Psychiatry 2001;179:540-4.
20. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med 2013;35:121-6.
21. Nelson-Quigg J, Cello K, Johnson C. Predicting binocular visual field sensitivity for monocular visual field results. Invest Ophthalmol Vis Sci 2004;41:2212-21.
22. Medeiros FA, Weinreb RN, Boer ER, Rosen PN. Driving simulation as a performance-based test of visual impairment in glaucoma. J Glaucoma 2012;21:221-7.
23. Mangione C, Lee P, Gutierrez P, Spiritzer K, Berry S, Hays R, et al. Development of the 25-item National Eye Institute Visual Function Questionnaire. Arch Ophthalmol 2001;119:1050-8.
24. Mykleund A, Stordal E, Dahl AA. Hospital Anxiety and Depression (HAD) scale: Factor structure, item analyses and internal consistency in a large population. Br J Psychiatry 2001;179:540-4.
25. Sharma R, Jain A, Shah A, Shah R. Association of anxiety and depression with glaucoma. International Multispecialty Journal of Health 2015;2:7-13.
26. Mabuchi F, Yoshimura K, Kashiwagi K, Shioe K, Yamagata Z, Kanba S, et al. High prevalence of anxiety and depression in patients with primary open-angle glaucoma. J Glaucoma 2008;17:552-7.
27. Dawudo O, Otakpor A, Ukonwurnw C. Common psychiatric disorders in glaucoma patients as seen at the University of Benin Teaching Hospital, Benin City, Nigeria. Journal of Biomedical Sciences 2004;3:42-7.
28. Kong X, Yan M, Sun X, Xiao S. Anxiety and depression are more prevalent in primary angle closure glaucoma than in primary open-angle glaucoma. J Glaucoma 2015;24;57-63.
29. Zhang X, Olson D, Le P, Lin FC, Fleischman D, Davis R. The association between glaucoma, anxiety and depression in a large population. Am J Ophthalmol 2017;183:37-41.
30. Zheng Y, Wu X, Lin X, Lin H. The prevalence of depression and depressive symptoms among eye disease patients: A systematic review and meta-analysis. Sci Rep 2017;7:46453.
31. Hwang M, Kim JL. Depression and anxiety in patients with glaucoma or glaucoma suspect. J Korean Ophthalmol Soc 2015;56:1089-95.
32. Wilson R, Coleman A, Yu F, Fong SI, Bing EG, Kim MH. Depression in patients with glaucoma as measured by self-report surveys. J Ophthalmol 2002;109:1018-22.
33. Lim NC, Fan CH, Yong MK, Wong EP, Yip LW. Assessment of depression, anxiety, and quality of life in Singaporean patients with glaucoma. J Glaucoma 2016;25:605-12.
34. Eshun V. Psychological experience of clients diagnosed with glaucoma in some selected clinics in Accra. MA Thesis. Methodist University College Ghana; 2015. Available from: ugspace.ug.edu.gh [Last accessed on 20 Oct 2014].