Associations Between Personality Traits and Adherence to Treatment in Patients with Primary Open Angle Glaucoma in an African Population

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Research Article

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Abstract

Purpose: There is poor adherence to medication among patients with glaucoma especially in people of African ancestry. The present study assessed the influence of personality traits on adherence to glaucoma medication among patients living with primary open angle glaucoma (POAG) from an African population.

Methods: A clinic-based cross sectional study was conducted among patients with POAG attending a specialist eye care facility. Adapted and validated personality trait and medication adherence measures questionnaires were used.

Results: Self-reported adherence to glaucoma medication was 60.8% but the overall mean adherence score was 18.58±3.40, indicating slight non-adherence. The personality traits conscientiousness and agreeableness significantly predicted medication adherence but accounted for only 30.3% and 13.3% of the variance respectively. Non-adherence to medication was significantly predicted by the personality profiles neuroticism, extraversion and openness which respectively accounted for 61.7%, 20.3% and 13.3% of the variance in the personality trait assessment. Old age and longer use of glaucoma medications were also significantly associated with non-adherence to glaucoma medication.

Conclusions: Glaucoma patients’ personality profiles significantly predicted their adherence to glaucoma medications. Assessment of the personality profiles and appropriate psychotherapeutic approaches should be included in glaucoma diagnosis and management protocols in order to enhance medication adherence in patients living with glaucoma.

Introduction

Glaucoma is the leading cause of irreversible blindness worldwide and the commonest form of the disease is the primary open-angle glaucoma (POAG) which is a chronic optic neuropathy often requiring lifelong treatment [1]. The burden of POAG, relating to higher prevalence, earlier age of onset, and more blinding, disproportionately affects people of African descent [2]. Ghana is known to have the highest prevalence of glaucoma in Africa and second globally, with St. Lucia reporting the highest prevalence [3, 4]. Lowering of intraocular pressure is the main objective of POAG management and this is often achieved through pharmacotherapy as the first line of choice, especially for newly diagnosed cases and in populations with low glaucoma surgery rates [5–7]. POAG as a non-life threatening, asymptomatic and gradual progressive disease offers little incentive for strict adherence to a lifetime therapeutic regimen [1, 8]. Non-compliance with glaucoma treatment has been associated with increased intraocular pressure, impaired visual acuity and worse visual field loss [8, 9]. There is considerable non-adherence to glaucoma medication in Ghana and has been described as having a major impact on clinical outcomes [10].

Patients on one or more intraocular pressure lowering medications have been found to exhibit unique sets of barriers to optimal adherence including reduced self-efficacy, difficulty instilling drops, forgetfulness, difficulties with medication schedule, suspicion that glaucoma will cause vision loss, mistrust that glaucoma medications are effective, mistrust in the physician, and perceived life stress [11–13]. These barriers are perceived as physical expressions of personality traits which may underline poor health seeking behaviors like medication non-adherence. Previous studies on this subject were founded on the reasoning that psychic trauma and emotional upsets could be a determinant in glaucoma aetiology and that comprehension of the psychology of the glaucoma patient could provide a foundation for a complete and successful treatment [14, 15]. Pappa et al found self-
reported non-compliance with glaucoma treatment to be associated with depression and suggested that assessment and treatment of depressive feelings could improve compliance in glaucoma patients [8]. In effect, practitioners could be managing the chronic condition well but the person's personality can be a formidable barrier to achieving a better prognosis leading to needless medication changes or surgical interventions.

POAG is a chronic condition which requires continues public health interventions. However, associations between personality traits and glaucoma medication adherence have not been extensively explored, especially in sub-Saharan Africa. Many studies have reported different personality profiles among glaucoma patients when compared to non-glaucoma controls [16–19]. It appears that certain personality profiles have predispositions to glaucoma etiology or that these personality traits rather develop as a consequence to the onset of glaucoma. Since research has revealed differences in personality traits within and between countries [20, 21], this study sought to investigate how personality trait dimensions relate to medication adherence of glaucoma patients attending a specialist eye clinic in Ghana. As glaucoma remains the commonest cause of irreversible blindness, it is envisaged that these findings will generate enough body of evidence to support public health interventions, and guide the development of patient specific treatment plans including assessment and treatment of personality deficits to enhance glaucoma treatment outcomes. To the best of our knowledge, no previous study has reported the associations between personality traits and adherence to treatment in POAG patients in sub-Saharan Africa, where glaucoma is most prevalent.

Materials And Methods

Study setting

The study was conducted at the Archbishop Ackon Memorial Christian Eye Centre which is a specialist eye care facility and a glaucoma referral centre in the Central Region of Ghana. The eye care workforce at this specialist eye centre consisted of ophthalmologists, optometrists, ophthalmic nurses and opticians. The daily ophthalmic patient attendance to the facility averages one hundred, of which close to 30% are glaucoma patients [7].

Study design and sampling

A cross sectional survey of patients with POAG was conducted between February and May, 2019. The sample for this study was 400 patients with POAG who were systematically sampled when they reported for routine reviews at this specialist eye facility. The sample size was determined using the formula \( N = Z^2 (1-p)(p)/b^2 \), where \( N = \) minimum sample size, \( z = \) the standard normal deviation, set at 1.96 which corresponds to the 95% confidence interval, \( p = \) estimated prevalence of 30% [7], \( b = \) degree of accuracy desired, usually set at 5%. Per this equation, the sample size was determined to be 323 which was adjusted to 400 participants to account for attrition rate and inefficiencies associated with the small sample size.

Inclusion and exclusion criteria

Eligibility for participation in the study was all patients who had been diagnosed of POAG and were receiving treatment at the specialist eye care facility for at least three months [22]. Diagnosis of glaucoma that met the inclusion criteria was based on a typical glaucomatous optic nerve head abnormalities on dilated fundoscopy (including notching, pallor, disc hemorrhages, vertical cup-to-disc ratio equal to or greater than 0.5 or difference in cup disc ratio of more than 0.2 in the two eyes); abnormal glaucoma hemifield test or a pattern deviation consistent with glaucoma (including temporal wedge, nasal step, altitudinal defect, partial arcuate defect etc.);
gonioscopically confirmed open anterior chamber angles [18, 23]. Further, patients were included if they had no history of psychotic illness, were not alcoholic or on drugs, and did not have dementia as indicated on their medical folders or through verbal responses. Participants were excluded if they were less than 18 years old, had other kinds of glaucoma (closed-angle, congenital or other secondary glaucomas), had a history of cognitive contra-indications like traumatic brain injury, seizure disorders, unstable ocular conditions (uveitis, cataract, recent trauma, diabetic retinopathy) and chronic medical conditions (diabetes, sickle cell, hypertension) [8, 19].

Research tools and measures

The Big Five Inventory Questionnaire

The Big Five Inventory questionnaire is made up of 44 items measuring five trait dimensions of personality [24]. These are extraversion (8 items), agreeableness (9 items), conscientiousness (9 items), neuroticism (8 items) and openness to experience (10 items). The items were measured on a five point Likert scale ranging from 1 = disagree strongly to 5 = agree strongly. Examples of items on the questionnaire include “tends to find fault with others”, “does a thorough job”, “is reserved”, “can be cold and aloof”. After the respondents answer the inventory, the options they choose on the Likert scale for the various items are summed for each trait dimension. Scores equal to or above the fiftieth percentile in a trait was graded high in that particular trait and scores below the fiftieth percentile were considered low. This classification was made to show where personality strengths and weaknesses of the participants placed. The dimension with the highest score is considered as the dominant personality trait of the respondent [25].

Medication Adherence Report Scale 5

The Medication Adherence Report Scale 5 (MARS-5) was used to measure participants’ self-reported adherence to their glaucoma medication regimens [26]. Each of the five items on the questionnaire was rated on a five point Likert scale from 1 = very often to 5 = never. Some items on the questionnaire include “I take less than instructed” and I stop taking it for a while”. Lower scores indicate lower levels of adherence and vice versa. Adherence was measured by computing the five individual items into a composite one with a total score range between 5 and 25; a score of 18.75 ((i.e., 75% of total score)) or less was categorised as non-adherence and a score above 18.75 as adherence [26].

Measured variables

The outcome variable in this study was glaucoma medication adherence scores and the predictive variables were personality trait dimension scores, demographic characteristics (age, gender, educational level), and duration of glaucoma drug use.

Procedures

Before the commencement of the data collection, a pilot study was carried out to ascertain the reliability and validity of the research questionnaires with a total of 40 conveniently sampled POAG patients. The outcome of the pilot study indicated that most of the participants found the questionnaire suitable, not stressful and easy to comprehend. After the responses were reviewed, some modifications were made to the items the respondents saw as confusing or difficult to comprehend. The Cronbach's alpha (internal consistency) for all the personality
subscales and MARS-5 ranged between 0.86 and 0.96. For participants who could read and write in the English language, the questionnaires were self-administered but for those who could not read and write in English, it was interviewer-administered.

**Ethical Considerations**

The research was approved by the University of Cape Coast Institutional Review Board (UCCIRB/CHAS/2018/47) and the study procedures adhered to the prescribed guidelines in the Declaration of Helsinki for research involving human subjects. Consent forms including local language versions were issued or read out to each participant to sign or thumb-print before enrolling them onto the study. Prior to issuance of consent forms, the rationale and purpose of the study were explained to each participant in the language they understood best. Also, permission was obtained from the management of the eye care facility before the commencement of the study. The patients were assured of confidentiality and anonymity as no names were included in the data recording.

**Statistical analysis**

All data were analysed using IBM SPSS version 23.0. The data were summarised as counts and percentages for categorical variables. Means adherence scores across demographic variables were initially explored using a one-way Analysis of Variance (ANOVA). Pearson's correlations were used to ascertain the direction and strength of relationship between the various personality trait dimensions and medication adherence scores. Subsequently, a forced entry multiple linear regression model was run to assess how the various personality trait dimensions and other independent variables could predict adherence to glaucoma treatment. The level of significance was set at p ≤ 0.05.

**Results**

A total of 400 glaucoma patients, with a mean age of 56.3 ± 16.2 (range: 19 to 89) years participated in the study. Most of the participants, 221 (52.8%) were females, but their ages did not differ significantly from that of the males (t = 0.770, p = 0.442). Majority 171 (42.8%) of the participants had no formal education and the average duration of glaucoma drug usage was 5.2 ± 3.8 years, ranging from 3 months to 18 years. Again, the majority of patients, 141 (35.3%) had their highest personality trait scores in the openness subscale, followed by conscientiousness 123 (30.8%), neuroticism 90(22.5%), agreeableness 38(9.5%), and extraversion 8 (2.0%). The ANOVA results showed that age and duration of medication usage had statistically significant association with medication adherence. The demographic characteristics with mean scores for medication adherence are presented in Table 1.
Table 1
Demographic characteristics of patients with their mean (standard deviation) scores for medication adherence

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n(%)</th>
<th>MARS-5 (Mean ± SD)</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>0.343</td>
</tr>
<tr>
<td>Male</td>
<td>189 (47.2)</td>
<td>18.75 ± 3.36</td>
<td>18.29–19.24</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>211 (52.8)</td>
<td>18.44 ± 3.44</td>
<td>17.99–18.88</td>
<td></td>
</tr>
<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>18–34</td>
<td>46 (11.5)</td>
<td>19.78 ± 3.31</td>
<td>18.80–20.83</td>
<td></td>
</tr>
<tr>
<td>35–50</td>
<td>90 (22.5)</td>
<td>19.42 ± 2.82</td>
<td>18.83–20.21</td>
<td></td>
</tr>
<tr>
<td>50–64</td>
<td>111 (27.8)</td>
<td>18.86 ± 3.21</td>
<td>18.25–19.46</td>
<td></td>
</tr>
<tr>
<td>65–80</td>
<td>140 (35.0)</td>
<td>17.69 ± 3.07</td>
<td>17.08–18.29</td>
<td></td>
</tr>
<tr>
<td>≥ 80</td>
<td>13 (3.2)</td>
<td>15.92 ± 3.40</td>
<td>14.70–17.78</td>
<td></td>
</tr>
<tr>
<td>Duration of medication use (years)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>&lt; 5</td>
<td>212 (53.0)</td>
<td>19.52 ± 2.99</td>
<td>19.11–19.92</td>
<td></td>
</tr>
<tr>
<td>5–9</td>
<td>143 (35.8)</td>
<td>17.84 ± 3.50</td>
<td>17.26–18.42</td>
<td></td>
</tr>
<tr>
<td>≥ 10</td>
<td>45 (11.2)</td>
<td>16.56 ± 3.52</td>
<td>15.50–17.61</td>
<td></td>
</tr>
<tr>
<td>Level of formal education</td>
<td></td>
<td></td>
<td></td>
<td>0.054</td>
</tr>
<tr>
<td>None</td>
<td>171 (42.8)</td>
<td>18.19 ± 0.249</td>
<td>17.70–18.68</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>160 (40.0)</td>
<td>18.75 ± 0.269</td>
<td>18.22–19.28</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>34 (8.5)</td>
<td>19.88 ± 0.586</td>
<td>18.69–21.07</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>35 (8.8)</td>
<td>18.49 ± 0.651</td>
<td>17.16–19.81</td>
<td></td>
</tr>
</tbody>
</table>

Medication Adherence

Most of the respondents 243 (60.75%) had a medication adherence score of more than 18.75 and so were classified as adherent but the overall mean glaucoma medication adherence score was (18.58 ± 3.403) indicating non-adherence.

Relationship Between Personality Trait Dimensions And Medication Adherence

Table 2 presents Pearson’s correlation between medication adherence, the five personality trait dimensions and some patient characteristics. There was a strong but negative relationship between neuroticism and medication adherence ($r = -0.77$, $p<0.001$). On the other hand, a significantly strong positive relationship was realised between
conscientiousness and medication adherence ($r = 0.71, p < 0.001$). There was a significantly moderate positive association between adherence to glaucoma medication regimen and the personality profile agreeableness ($r = 0.419, p < 0.001$). Age of patient significantly and negatively correlated with medication adherence and all personality subscales except for neuroticism. Similarly, duration of drug use negatively correlated with adherence and all the personality subscales except for neuroticism. A significantly moderate positive correlation was observed between duration of glaucoma medication use and neuroticism trait ($r = 0.419, p < 0.001$), indicating that the longer neurotic patients continued to use their medications the more they exhibited neurotic tendencies. Again, older patients and longer use of glaucoma medications were associated with non-compliance.

Table 2
Pearson's correlation between the Big Five personality traits and glaucoma medication adherence

<table>
<thead>
<tr>
<th>Variables</th>
<th>MARS-5</th>
<th>Extraversion</th>
<th>Agreeableness</th>
<th>Conscientious</th>
<th>Neuroticism</th>
<th>Openness</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARS-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraversion</td>
<td>0.215**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreeableness</td>
<td>0.419**</td>
<td>0.266**</td>
<td>0.209**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.719**</td>
<td>0.273**</td>
<td>0.209**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.770**</td>
<td>-0.486**</td>
<td>-0.531**</td>
<td>-0.814**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Openness</td>
<td>0.180**</td>
<td>0.185**</td>
<td>0.337**</td>
<td>0.348**</td>
<td>-0.426**</td>
<td></td>
</tr>
<tr>
<td>Age of patient</td>
<td>-0.282**</td>
<td>-0.114*</td>
<td>-0.114*</td>
<td>-0.392**</td>
<td>0.373**</td>
<td>-0.216**</td>
</tr>
<tr>
<td>Duration of drug use</td>
<td>-0.349**</td>
<td>-0.093ns</td>
<td>-0.182**</td>
<td>-0.439**</td>
<td>0.419**</td>
<td>-0.208**</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

ns non-significant association

Multiple Linear Regression Between Predictive And The Outcome Variables

We performed a multiple linear regression to evaluate how personality traits could predict medication adherence among the glaucoma patients. A forced-entry regression was run to assess the contribution of all predictor variables at the same time, and the overall regression model could explain 67.3% of the variance in the data ($R^2 = 0.673, F_{(5, 394)} = 165.5, p < 0.001$). As shown in Table 3, all the personality trait dimensions significantly predicted the patients' adherence to glaucoma medication regimen. The highest predictor of non-adherence was the personality trait neuroticism, accounting for 61.7% of the variance in glaucoma medication non-adherence ($\beta = 0.617, t = -8.45, p < 0.001$), where a unit increase in neuroticism score corresponded to a non-adherence score of 0.24. Conscientiousness was the most significant personality dimension associated with glaucoma medication adherence which accounted for 30.3% of the variance in glaucoma medication adherence. A unit increase in the score of conscientiousness corresponded to an adherence score of 0.17. Again, as the age of a glaucoma patient increased by one year, he/she became non-adherent to glaucoma medication by a score of 0.04. Similarly, an
increase in one year duration of glaucoma medication use corresponded to non-adherence score of 0.26. Gender did not predict a patient's adherence to glaucoma medication in this population. When compared to tertiary level education, only patients who had secondary education showed a significant association with adherence to glaucoma medication, but having primary education or no formal education did not significantly predict a patient's adherence to glaucoma medication regimen.

<table>
<thead>
<tr>
<th>Predictive variables</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality trait profiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.243</td>
<td>0.029</td>
<td>-0.617</td>
<td>-8.498</td>
<td>0.001</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.171</td>
<td>0.033</td>
<td>0.303</td>
<td>5.235</td>
<td>0.001</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.100</td>
<td>0.016</td>
<td>-0.203</td>
<td>-6.326</td>
<td>0.001</td>
</tr>
<tr>
<td>Extraversion</td>
<td>-0.146</td>
<td>0.031</td>
<td>-0.160</td>
<td>-4.666</td>
<td>0.001</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>0.074</td>
<td>0.022</td>
<td>0.133</td>
<td>3.400</td>
<td>0.001</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of Participants</td>
<td>-0.035</td>
<td>0.013</td>
<td>-0.166</td>
<td>-2.638</td>
<td>0.009</td>
</tr>
<tr>
<td>Duration of Glaucoma Drug Use</td>
<td>-0.255</td>
<td>0.051</td>
<td>-0.282</td>
<td>-4.965</td>
<td>0.001</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>–</td>
</tr>
<tr>
<td>Male</td>
<td>0.319</td>
<td>0.321</td>
<td>-0.046</td>
<td>0.925</td>
<td>0.356</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>–</td>
</tr>
<tr>
<td>Secondary</td>
<td>1.533</td>
<td>0.769</td>
<td>0.14</td>
<td>1.995</td>
<td>0.047</td>
</tr>
<tr>
<td>Primary</td>
<td>0.912</td>
<td>0.601</td>
<td>0.08</td>
<td>1.518</td>
<td>0.130</td>
</tr>
<tr>
<td>No formal education</td>
<td>0.920</td>
<td>0.612</td>
<td>0.08</td>
<td>1.504</td>
<td>0.133</td>
</tr>
</tbody>
</table>

**Discussion**

Medication adherence is key to achieving successful treatment outcomes in glaucoma management. This study reports the influence of personality traits on medication adherence of glaucoma patients from a population of high glaucoma burden where there is over reliance on pharmacotherapy as the treatment option. The neuroticism personality trait was the most significant predictor of non-adherence among the glaucoma patients whereas adherence was significantly predicted by the personality profiles conscientiousness and agreeableness. Older patient age and longer use of glaucoma medications were also significantly associated with non-compliance to glaucoma medication. A previous study that used retrospective patient data estimated that about 91% of
glaucoma patients in Ghana did not fully adhere to their medication regimens [10]. Using the Medication Adherence Report Scale 5, the present study found self-reported adherence to glaucoma medication to be 60.8% among a cohort of glaucoma patients.

Varying levels of adherence to glaucoma medication have been reported globally, ranging from 61.4% in Ethiopia [27], 63.2% in Nigeria [28], 73.0% in the USA [13], and 77% in Hungary [29]. Apart from population-specific factors such as income levels, urbanisation and health insurance coverage [10, 27, 28], the diversity of methodological approaches may also account for the differing reported adherence levels by the various studies. Glaucoma patients have been particularly described as non-adherence to their medications when compared to patients with other chronic diseases. Yeaw et al. have documented that persistence and adherence to glaucoma medications were significantly lower than that for hyperlipidemia, osteoporosis, diabetes, overactive bladder, and hypertension [30]. Other barriers including African ancestry [22] and personality profiles have been documented to account for the significant medication non-adherence among glaucoma patients. The current study revealed that the neuroticism personality trait was the highest predictor of non-adherence accounting for the highest variance (61.7%) in the analysis of all the personality subscales ($\beta = 0.617, t = -8.45, p < 0.001$). Similar trends have also been described among glaucoma patients across many populations [16, 17, 19, 31]. Again, a review of literature on psycho-ophthalmology suggests a greater level of psychopathology amongst glaucoma patients such as hysteria, hypochondriasis, depression, stress and anxiety [8, 18, 19, 32–35]. Mabuchi et al reported that patients with glaucoma recorded significantly higher scores for neuroticism than patients with cataracts [17]. All these findings suggest that there is something characteristic of a glaucoma diagnosis that is associated with medication non-adherence or feelings of ill health. For instance, a glaucoma diagnosis may ignite worries of blindness and consequent loss of physical and financial independence [36]. Again, there is evidence of psychophysiological reactivity to ocular hypertension where high levels of anxiety were found to increase intraocular pressure (IOP) to clinically significantly degrees [34, 37]. The physiological basis for this phenomenon may be related to the sympathetic and parasympathetic regulation of aqueous humor dynamics [34, 38].

Next to neuroticism, the conscientiousness trait had the second highest variance (30.3%) in the personality trait regression analysis. Conscientiousness, however, had a positive outlook, predicting adherence with glaucoma medication. Conscientious individuals often exhibit positive life tendencies such as self-discipline, self-control, determination, and hardworking which are associated with positive health outcomes [17, 39]. Scores in the agreeableness subscale also predicted patients’ adherence to glaucoma medication regimes in this study but this trait accounted for only 13.3% of the variance in the data. Relatedly, Chen et al. and Mabuchi et al. in case-control studies among glaucoma cases and non-glaucoma controls, found that glaucoma patients recorded significantly higher levels of neuroticism but lower scores for openness and extraversion [17, 19]. Chen et al. actually found a positive relation between openness and agreeableness and positive health seeking behavior in a Chinese glaucoma population [19]. In contrast to these previous findings, the present results indicated that extraversion and openness traits predicted non-adherence. Though both extraversion and openness trait dimensions have some positive facets like sociability, optimism, creativity and enthusiasm they have been reported to associate with health-risk behaviors while agreeableness and conscientiousness where less associated with such risky endeavours [17, 40, 41]. It therefore clear that personality trait assessment in respect of medication compliance in this study presented a more negative outlook as the highest variance in the analysis was accounted for by non-adherence tendencies. To achieve successful treatment outcomes in patients with glaucoma, protocols for glaucoma management could include the assessment of patient’s personality profiles in order to tailor care and treatment to the individual and personal levels. For patients with high scores in neuroticism, psychotherapeutic
management should also be sought in order to enhance medication adherence. Nakano et al. [31] have advocated that since individuals with high neuroticism are sensitive to negative emotions, glaucoma prognostic information could be provided to them from an optimistic viewpoint such as “this medication will prevent 80% of patients with glaucoma from going blind”. On the other hand, for individuals with low neuroticism, prognostic information should be formulated from a pessimistic perspective like “20% of patients will go blind whether or not they receive this medication”. These approaches will enhance compliance.

The burden of glaucoma is known to be high among the aged due to the difficulty in diagnosing glaucoma early and the fact that age related tissue changes contribute to the progression of glaucoma [42]. Our finding that medication adherence reduced with increasing age and that old age also correlated with high scores for neuroticism could portend a double jeopardy for the older glaucoma population. Results of the present study further revealed that older patients and longer use of glaucoma medications were associated with non-compliance. The development of age specific treatment plans, taking into account the individuals’ personalities will improve adherence among this at risk population. In addition to what has been mentioned earlier, practitioners could adopt some recommended adherence strategies like enforcing regular reviews, patient education, giving written instructions to patients and the inclusion of such patients in national health insurance schemes [10, 43, 44].

A limitation for this study was the use of self-report to measure personality traits and medication adherence, making it susceptible to social desirability bias especially for medication adherence and a tendency for a recall bias.

**Conclusion**

Glaucoma patients’ personality profiles significantly predicted their adherence to glaucoma medications. The neuroticism domain was associated with non-adherence and accounted for the highest variance in the analysis of all the personality traits. This was followed by the conscientiousness subscale which significantly predicted adherence. Extraversion and agreeableness respectively contributed 20.2 and 1.16 to the variance and were both associated with non-adherence. Glaucoma diagnosis and management protocols should include assessment of personality profiles and psychotherapy as appropriate.

**Declarations**

**Funding**

This study received no funding

**Compliance with ethical standards**

**Conflict of interest**

None of the authors has any proprietary interests or conflicts of interest related to this submission

**Ethical approval**

The research was approved by the University of Cape Coast Institutional Review Board and the study procedures adhered to the prescribed guidelines in the Declaration of Helsinki for research involving human subjects.
Informed consent

Informed consent was obtained from all individual participants included in the study.

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