

# Severity of Primary Open-angle Glaucoma and Female Sexual Dysfunction among Older Adults in Malaysia

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Received on: 01 December 2024; Accepted on: 26 December 2024; Published on: 20 January 2025

## ABSTRACT

**Aims and background:** The objective of this study is to determine the prevalence of female sexual dysfunction (FSD) in older adults with primary open-angle glaucoma (POAG) and its correlation with the severity of visual field (VF) defects. Additionally, potential associated factors with FSD were identified.

**Materials and methods:** This cross-sectional study included a total of 210 female patients with POAG, aged between 40 and 80 years, from three tertiary centers in two states of Malaysia, conducted between September 2019 and 2020. FSD was assessed using the self-administered Bahasa Malaysia version of the Female Sexual Function Index-6 (MvFSFI-6), with scores of  $\leq 19$  indicating FSD. The severity of POAG was evaluated using the modified Advanced Glaucoma Intervention Study (AGIS) scoring system, predicated on two reliable consecutive VFs evaluated by two masked investigators, categorizing the condition as mild, moderate, or severe. Medical records were reviewed for POAG management and other systemic comorbidities. Sociodemographic data, including education and living status, were obtained from the participants.

**Results:** The participants' average age was 66.7 (7.9) years. The prevalence of FSD is 78.5%. MvFSFI-6 scores decreased with age ( $r = -0.88$ ;  $p < 0.001$ ) and revealed an exponential decline with increasing AGIS scores ( $r = -0.238$ ,  $p = 0.010$ ). Higher education was correlated with a 67% decreased possibility of experiencing FSD (OR = 0.33, 95% CI 0.12–0.88).

**Conclusion:** FSD is common among female patients with POAG. Sexual well-being is a crucial factor for women with POAG, particularly those with severe VF defects and lower education levels. Ophthalmologists, gerontologists, and women's health experts need to address this issue to ensure a better quality of life (QoL) for older adults.

**Clinical significance:** Sexual dysfunction (SD) among women with POAG increases with the severity of the disease, especially among those with lower education levels. To ensure a good QoL for these women, sexual function should be included in the comprehensive management of POAG.

**Keywords:** Advanced glaucoma interventional study score, Female sexual dysfunction, Gender equality, Good health and well-being, Older adults, Primary open-angle glaucoma.

*Journal of Current Glaucoma Practice* (2024): 10.5005/jp-journals-10078-1465

## INTRODUCTION

The aging process predisposes older adults to many chronic diseases, including primary open-angle glaucoma (POAG). POAG is defined by chronic progressive optic neuropathy, accompanied by changes in morphology in the optic nerve head (ONH) and a decrease in the thickness of the retinal nerve fiber layer (RNFL), correlating with visual field (VF) impairment.<sup>1</sup> It is known to cause bilateral, irreversible, painless progressive loss of vision, significantly affecting activities of daily living (ADL).<sup>2</sup>

Improvements in health care and the economy have led to increased longevity, especially in Asia, which has the highest prevalence of blindness due to glaucoma.<sup>3–5</sup> World Health Organization (WHO) global health observatory statistics indicate that women's life expectancy exceeds that of men by 6–8 years.<sup>6</sup> Life expectancy varies depending on the geographical and economic status of countries.<sup>7</sup> Therefore, it is crucial to ensure a good quality of life (QoL) along with reducing dependency among aging women.<sup>8</sup>

Most ADLs defining independence and efficiency necessitate clear vision. The most devastating consequence of glaucoma is the progressive loss of independence due to advancing visual impairment, which negatively impacts both physical and mental health.<sup>9,10</sup> Mental health includes psychological well-being, and sexual function is one of the components. Sexual function is often neglected in older adults, especially in women, due to the belief

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**How to cite this article:** Chee CC, Sabah H, Yaakub A, et al. Severity of Primary Open-angle Glaucoma and Female Sexual Dysfunction among Older Adults in Malaysia. *J Curr Glaucoma Pract* 2024;18(4): 155–161.

that sexual interest wanes with age.<sup>11</sup> Physiologically, aging and hormonal reduction commonly lead to sexual dysfunction (SD) in women, characterized by a lack of sexual desire and arousal.<sup>12</sup> Vision is an important stimulus for sexual desire and arousal.<sup>13</sup> Although there is no direct relationship between female sexual dysfunction (FSD) and visual impairment, visual impairment in POAG may exacerbate preexisting FSD.<sup>14,15</sup>

Menopausal women are more sensitive to psychological pressure, particularly anxiety and depression, as they undergo a wide range of biopsychosocial changes.<sup>16</sup> Emotional distress related to the treatment burden of POAG and the fear of blindness may further negatively impact FSD.<sup>17</sup> Common systemic comorbidities among older adults, such as diabetes and hypertension, may also contribute to FSD.<sup>16,18</sup> FSD is rarely discussed among patients and medical professionals. Improving FSD may help increase QoL and indirectly improve adherence to and persistence with glaucoma treatment.<sup>19</sup> Detecting FSD among POAG patients is important. However, there is no reported association between FSD and POAG. This study aims to determine the prevalence of FSD and its associated factors among female patients with POAG in Malaysia.

## MATERIALS AND METHODS

### Participants

This cross-sectional study was carried out using a validated Bahasa Malaysia version of the Female Sexual Function Index-6 (MvFSFI-6) questionnaire between September 2019 and 2020. All subjects were enrolled from three glaucoma clinics of hospitals in Malaysia: Hospital Raja Perempuan Bainun, Ipoh; Hospital Universiti Sains Malaysia; and Hospital Raja Perempuan Zainab II, Kota Bharu. This study received ethical approval from the Human Research Ethics Committee of Universiti Sains Malaysia and the National Malaysia Research Registry and was conducted in accordance with the Declaration of Helsinki for human research.

The participants were female patients with POAG, aged between 40 and 80 years old, and on regular follow-up in these three hospitals. POAG is characterized by the presence of glaucomatous optic nerve damage, both structurally and functionally, in an eye with an open angle and without identifiable pathology.<sup>20</sup> They are married, and their partners are alive. Inclusion criteria required participants to provide two consecutive reliable VFs within 4 months of the recruitment period. A total of 245 patients were initially recruited, but 35 could not present two reliable VFs. Reliability of the VF is defined based on the reliability indices: fixation loss <20%, false positive, and false negative response rate <33%.<sup>21</sup> Ocular examination was also conducted to exclude any secondary glaucoma and to determine the angle status of the eye. Those with secondary glaucoma were excluded. Medical records were retrieved, and those with preexisting FSD, gynecological problems including posthysterectomy or oophorectomy, and those who received hormonal replacement therapy were also excluded. Mental status was assessed using the Mini-Mental State Examination (MMSE) to rule out any impaired cognitive function.

### Malay Version Female Sexual Function Index-6 Questionnaire

The MvFSFI-6 questionnaire was used in this study, which comprised six items: sexual desire disorder, sexual arousal disorder, lubrication, orgasmic disorder, sexual dissatisfaction, and sexual pain disorder.

**Source of support:** Nil

**Conflict of interest:** None

This questionnaire is a simplified, self-reported version derived from the original 19-item FSFI.<sup>22</sup> The FSFI-6 provides a quick assessment of FSD.<sup>22</sup> The Bahasa Malaysia version of FSFI, known as the Malay FSFI (MvFSFI), is the translated and validated version, widely used in the evaluation of FSD in the Malaysian population. The Malay version of FSFI-6 is the shorter version of MvFSFI. This six-item questionnaire is scored from 0 to 5 using a Likert scale for each item, with a maximum score of 30. FSD is defined when the total score ≤19, which indicates the need for further evaluation.<sup>23</sup>

### Modified Advanced Glaucoma Intervention Study Score

Visual field assessments were performed with the Humphrey Visual Field Analyzer (Carl Zeiss Meditec, Dublin, CA) utilizing the 24-2 Swedish Interactive Threshold Algorithm (SITA) standard analysis. The severity of POAG is assessed using the Modified Advanced Glaucoma Intervention Study (AGIS) score, based on the better-seeing eye's performance on two consecutive reliable VFs within a 4-month period. If the first VF is not reliable, another VF assessment is repeated within a month. Patients were excluded after four attempts at a nonreliable VF. Two masked investigators (AY and LS) were responsible for scoring the VF. They scored individually and were masked from each other's findings. The average score is then categorized as mild (score of 1–5), moderate (score of 6–11), and severe (score of 12–20).<sup>24</sup>

### Evaluating the Factors–Associated Female Sexual Dysfunction

Patients' relevant information was reviewed from the medical record and/or direct questioning: socioeconomic status, previous medical history (diabetes mellitus, hypertension, and hyperlipidemia), number and class of glaucoma medications (beta-blocker, prostaglandin analogue, alpha agonist, carbonic anhydrase inhibitor), and previous eye surgeries. Duration of the disease and previous ocular history, including glaucoma surgery, were also obtained. Information on monthly individual income for those still employed or receiving pensions or any retirement financial scheme, as well as educational attainment, was also obtained from the patients. Those who received informal education and primary education were grouped as lower education level, and those with secondary education level and above were grouped as higher education level for the purpose of statistical analysis.

### Patient Evaluation and Data Collection Procedures

They were also asked about the presence of their systemic comorbidities and other sociodemographic data. Medical records on ophthalmic, obstetrics and gynecology, and other systemic diseases were traced and documented. If they were uncertain of their health status or medication, phone calls were made to the outpatient clinic or general practitioners to retrieve information on their systemic comorbidities. They were asked to answer the questionnaire on their own in a special area of the clinic. The special area was slightly secluded to ensure privacy for the patient with good lighting. A trained female personnel was assigned to assist or clarify any questions for the illiterate participants. If this was required, the trained personnel read the question directly from the

questionnaire without any changes. The participants then returned the questionnaire to the primary investigator (CCC).

### Statistical Analysis

The data were evaluated using SPSS Version 26.0 (IBM SPSS Statistics 26). FSD was analyzed as presence or absence, determined by the MvFSFI-6 questionnaire score. Descriptive statistics were applied to analyze demographic data, ocular parameters, as well as outcome measures. One-way analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used to assess the association between mean score FSD and severity of glaucoma based on the AGIS score. Age, educational level, systemic hypertension, diabetes mellitus, hyperlipidemia, and topical beta-blockers were considered as confounding factors in the ANCOVA analysis. These factors were also included as potential associated factors of FSD using multiple logistic regression. Pearson correlation was employed to evaluate the potential correlation between MvFSFI-6 score with age and AGIS score. A  $p$ -value  $< 0.05$  was considered statistically significant.

**Table 1:** Sociodemographic characteristic of women with POAG

Variables	Female (N = 210)	
	Mean (SD)	N (%)
Age (years)		
40–49	66.7(7.9)	5 (2.4)
50–59		44 (21.0)
60–69		74 (35.2)
70–80		87 (41.4)
Race		
Malay		116 (55.2)
Chinese		90 (42.9)
Indian		4 (1.9)
Individual income		
USD 125 and below		153 (72.9)
USD 126–375		29 (13.8)
USD 376–625		26 (12.4)
USD 626–875		2 (1.0)
>USD 875		0 (0.0)
Education level		
Informal		61 (29.0)
Primary		69 (32.9)
Secondary		77 (36.7)
Tertiary		3 (1.4)
Systemic comorbidity		
None		14 (6.7)
Single comorbidities		
DM		38 (18.1)
HPT		32 (15.2)
HPL		20 (9.5)
Multiple comorbidities		
DM + HPT		46 (21.9)
DM + HPL		2 (1.0)
HPT + HPL		37 (17.6)
All of above		21 (10.0)

DM, diabetes mellitus; HPL, hyperlipidemia; HPT, hypertension; POAG, primary open-angle glaucoma

## RESULTS

### Sociodemographic and Clinical Information of Participants

This study included a total of 210 participants. The average age of the participants was 66.7 (7.9) years, with 41.4% of the participants falling within the 70–80-year age range and 35.2% being between 60 and 69 years (Table 1). The distribution of races almost reflected the Malaysian population. Almost a third of the female patients with POAG did not receive any formal education (29.0%). Nearly three-quarters (72.9%) had individual income less than USD 125. Diabetes mellitus and hypertension were the most common systemic comorbidities (21.9%) (Table 2). The mean duration of POAG (since the diagnosis) was 7.6 (4.1) years, and 97.1% had bilateral eye involvement (Table 2). The majority were on medical treatment, with 40.5% treated with topical beta-blocker alone.

### Prevalence of Female Sexual Dysfunction in Female Patients with Primary Open-angle Glaucoma

The prevalence of FSD among female patients with POAG was 78.5% (Table 3). There was an absence of FSD among those between 40 and 49 years old, but it increased to 100.0% among those between 70 and 80 years old (Table 3). There was a significant negative relationship between MvFSFI-6 score and age; the score declined with increased age ( $r = -0.88$ ;  $p < 0.001$ ) (Fig. 1). The

**Table 2:** Ocular parameter in women with POAG

Variables	Mean (SD)	N (%)
Duration of disease (years)	7.6 (4.1)	
Laterality		
Right		3 (1.4)
Left		3 (1.4)
Bilateral		204 (97.1)
Severity of POAG (AGIS score)		
Mild		26 (12.4)
Moderate		91 (43.3)
Severe		93 (44.3)
Topical IOP-lowering agents		
Beta-blocker		85 (40.5)
Prostaglandin analog		44 (21.0)
Carbonic anhydrase inhibitor		0 (0.0)
Alpha agonist		0 (0.0)
Glaucoma surgery		18 (8.6)

AGIS, advanced glaucoma intervention study score; IOP, intraocular pressure; POAG, primary open-angle glaucoma

**Table 3:** Prevalence of FSD according to age-group

Age-group	Presence of FSD (N)	Total N (%)
40–49	0	5 (0.0)
50–59	16	44 (36.0)
60–69	62	74 (83.8)
70–80	87	87 (100)
Total N (%)	164	210 (78.5)

FSD, female sexual dysfunction

majority of the participants (50.5%) almost never or never had desire for sex. Nearly half of them did not have sexual activity for the past 4 weeks at the time of answering the questionnaire and scored 0 for the domain of sexual arousal, lubrication, orgasmic disorder, and sexual pain. Although the majority of participants had no sexual activity in the past 4 weeks prior to answering the

questionnaire, 51% of the participants rated moderate satisfaction for sexual activity.

### MvFSFI-6 Score and Severity of Primary Open-angle Glaucoma (AGIS Score)

There was a statistically significant association between MvFSFI-6 score and severity of glaucoma ( $p < 0.001$ ) (Table 4). The mean score of MvFSFI-6 was significantly lower in patients with severe POAG. The mean score reduced as the severity increased (Table 4). However, the analysis revealed no significant correlation between the MvFSFI-6 score and the severity of glaucoma after accounting for factors that influenced it ( $p = 0.077$ ) (Table 4). Furthermore, a significant negative correlation was found between MvFSFI-6 score and AGIS score ( $r = -0.238$ ,  $p = 0.01$ ) (Fig. 1).

### Predictors of Female Sexual Dysfunction in Patients with Primary Open-angle Glaucoma

Based on Table 5, there was a statistically significant relationship between FSD and educational level attainment ( $p < 0.050$ ) when adjusted for age, systemic comorbidities (diabetes mellitus, hypertension, hyperlipidemia), and beta-blocker. Women with an increased educational level exhibited 67% lower odds of experiencing FSD in comparison with women with a lower educational level (OR = 0.33, 95% CI; 0.12, 0.88). Otherwise, systemic comorbidities and beta-blocker were not found to be significant independent predictors for FSD in female patients with POAG.

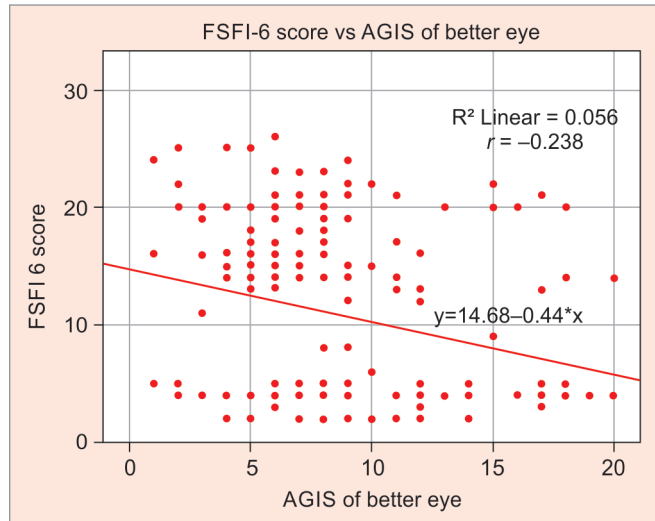


Fig. 1: Scatterplot of FSD severity (as measured by FSFI-6 score) and AGIS score of a better eye ( $r = -0.238$ ,  $p = 0.012$ )

Table 4: FSFI-6 score among POAG patients according to severity (mild, moderate, severe) ( $n = 210$ )

Variables	Severity of glaucoma			F-stat	p-value
	Mild Mean (95% CI)	Moderate Mean (95% CI)	Severe Mean (95% CI)		
FSFI-6 score	13.85 (11.02, 16.67)	12.47 (10.96, 13.98)	8.68 (7.18, 10.17)	8.53	<0.001 <sup>a</sup>
	12.23 (10.57, 13.89)	11.60 (10.42, 12.78)	9.99 (8.62, 11.36)	2.61	0.077 <sup>b</sup>

FSFI-6, female sexual function index-6; <sup>a</sup>One-way ANOVA was applied.  $p$ -value < 0.05 was considered statistically significant; <sup>b</sup>One-way ANCOVA was applied (adjusted for age, systemic comorbidities, and topical beta-blocker) (mild vs moderate -0.64 (-1.85, 3.13), >0.950; mild vs severe 2.24 (-0.40, 4.89), 0.126; moderate to severe 1.61 (-0.62, 3.84), 0.250.  $p$ -value < 0.05 was considered statistically significant

Table 5: Predictors of FSD in patients with POAG ( $n = 210$ )

Variables	Simple logistic regression		Multiple logistic regression	
	crude OR (95% CI)	p-value	adjusted OR (95% CI)	p-value
Age	1.05 (1.00, 1.09)	0.031	1.00 (0.94, 1.07)	0.950
Education level				
Low educational level	—		—	
High educational level	0.32 (0.16, 0.62)	0.001	0.33 (0.12, 0.88)	0.027
Systemic comorbidities DM				
No	—		—	
Yes	1.39 (0.72, 2.71)	0.326	1.18 (0.56, 2.49)	0.673
HPT				
No	—		—	0.462
Yes	1.46 (0.75, 2.87)	0.270	1.31 (0.64, 2.71)	0.462
Dyslipidemia				
No	—		—	0.106
Yes	0.51 (0.26, 0.98)	0.045	0.54 (0.25, 1.14)	0.106
Topical beta-blocker				
No	—		—	
Yes	0.51 (0.20, 1.31)	0.162	0.47 (0.17, 1.26)	0.131

DM, diabetes mellitus; FSD, female sexual dysfunction; HPT, hypertension; OR, odds ratio. Assumption met (classification table = 78.1%, Hosmer–Lemeshow test = 0.865, AUC = 0.71, 95% CI = 0.62, 0.79)



## DISCUSSION

Sexual health is important for subjective well-being (SWB) in older adults.<sup>25</sup> SWB is a key indicator for successful aging, particularly among partnered older adults.<sup>26</sup> SD, including FSD, is underreported, especially in Asia.<sup>27,28</sup> In this study, we included only female patients with POAG who are still married, and their partners are still alive. Thus, assuming they are still sexually active.

The sexual function of older adults is strongly linked to both their physical and mental well-being. Sexual desire and sexual arousal in women are more complex than in men.<sup>29</sup> Identifying sexual stimuli in women presents challenges, as numerous factors influence female arousal. These include personal relationships, family dynamics, child-related issues, emotional and physical well-being, menstrual cycles, and many others.<sup>29–31</sup> Visual impairment has been linked to a diminished sexual self-concept, encompassing aspects such as sexual anxiety, sexual self-efficacy, sexual self-esteem, sexual fear, and sexual depression. Visual cues are one of the subscales being used to assess sexual desire, indicating vision may play a role in triggering sexual thought.<sup>32,33</sup> VF is a component of vision, which may be affected by optic nerve pathology. Visual stimuli were found to improve dyspareunia, which supports the importance of good vision in sustaining sexual function among women.<sup>34,35</sup> There are findings on erectile dysfunction in patients with cataract and glaucoma.<sup>36,37</sup> However, there is no study implicating visual impairment in FSD. This cross-sectional study attempts to study the effect of constriction of the VF in POAG on sexual function in older adult women.

The prevalence of FSD was 78.5% among women with POAG in our study. A previous study in Malaysia, conducted among women older than 50 years, reported the prevalence of FSD as 68.8%.<sup>27</sup> Almost all our recruited female patients with glaucoma were already postmenopausal. The prevalence of FSD among older adults in Asia varies between 75.2 and 81.5%.<sup>27,38–40</sup> The prevalence of FSD in older adults with POAG is almost like the prevalence reported in postmenopausal women. Menopausal women have a lack of estrogen, giving rise to vaginal dryness and dyspareunia.<sup>41,42</sup> Their sexual arousal and desire are also affected by the lack of estrogen.<sup>31</sup>

It has been observed that the severity of POAG correlates with the decline of sexual function, emphasizing the broader impacts of this condition beyond just visual impairment.<sup>43,44</sup> For instance, studies using the NEI VFQ-25 and GQL-15 questionnaires in different populations,<sup>43,44</sup> including Chinese patients with glaucoma, have reported significant associations between VF loss and various QoL aspects, such as dependency, social functioning, and mental health. These findings underscore the complex ways in which glaucoma and its progression can affect patients' lives, beyond the direct effects of vision loss alone.<sup>44</sup> The existing fear of being blind, anxiety, and depression worsen as the constriction of the VF progresses.<sup>45</sup> Sexual desire and arousal in women are easily affected by stress, which causes distraction from sexual cues.<sup>46,47</sup> This psychological impact of POAG may indirectly contribute to the existing lack of sexual desire in menopausal women. However, the present study did not include any data on the psychological impact of POAG.

Malaysia version of the Female Sexual Function Index-6 is the shortened version of the FSFI-6 questionnaire in Bahasa Malaysia, used in this study to ease the participants and improve the reliability of their responses. In addition, MvFSFI-6 requires a shorter time for completion, which is ideal for older adults. FSD

was found to increase exponentially with increasing age: the MvFSFI-6 score had a strong negative correlation with age. Our findings are consistent with previously reported studies.<sup>48,49</sup> While the severity of POAG increases with age,<sup>50</sup> these connections give rise to the question: are the current findings due to physiological changes in aging women, or is there a link with glaucoma? To answer this question, an age-matched group of women without glaucoma as the control group is essential. The absence of this control group is the major weakness in the present study. However, since the main aim of the present study is to understand the impact of the severity of POAG on FSD, the presence of this control group is not essential. In addition, age is not found to be a significant associated factor affecting FSD in our study. Nonetheless, after adjusting for additional variables such as age, no significant correlation was found between FSD and the severity of POAG.

Socioeconomic background, cultural status, interrelation with their partners, and education status intermingle in most studies on FSD.<sup>51,52</sup> In this study, we recruited married women but without any information on their husbands. Age, presence of erectile dysfunction, and systemic comorbidities are among the important information about their husbands. Sexual drive of their husbands plays an important role in their sexual functioning.<sup>53</sup> This is another weakness in the present study.

A higher prevalence of FSD was observed among older adult women who had lower educational attainment, were unemployed, had chronic diseases, experienced multiparity, and were in menopause.<sup>25,54</sup> Based on our study, a lower educational level is linked with a greater risk of FSD in women with POAG. Low educational level is associated with low health literacy. It is strongly related to poorer health outcomes<sup>55</sup> and low health awareness.<sup>56,57</sup> For a similar reason, a higher prevalence of glaucoma is reported in areas with lower income in many countries (refs). High socioeconomic status is believed to have a positive impact on well-being in later life due to higher participation in social activities than those with low socioeconomic status.<sup>58,59</sup>

However, this cross-sectional study could fail to accurately depict the actual effect of FSD in patients with POAG. The score may change depending on their understanding, memory, and emotion at the time of answering the questionnaire. The response could have been different if a different time had been selected. Future studies could involve administering questionnaires on two separate occasions. The questionnaire-based study is susceptible to recall bias. Older adults may struggle to recall their daily activities or feel uneasy responding to specific inquiries, particularly regarding their sexual health. As a result, they may not have disclosed all pertinent information. Conversely, they may have exaggerated their issues. Nonetheless, it is challenging to eradicate these biases in a questionnaire-based study.

## CONCLUSION

In conclusion, FSD is common among older adult women with POAG, especially those with lower education levels. There was a significant negative correlation between FSD and AGIS score. The impact of the severity of glaucoma on FSD diminished when age, systemic comorbidities, and topical beta-blockers were included. However, detection of FSD is important to improve SWB and QoL among older adults with POAG. SWB and QoL are important to ensure happy aging in those with visual impairment secondary to POAG.

## Clinical Significance

The current study highlights the potential correlation of vision impairment, specifically glaucoma, with sexual health in females. By exploring this relationship, the study may contribute to improving holistic care and treatment plans for older adults with glaucoma, addressing both physical and psychological aspects of health.

## ETHICAL APPROVAL AND PATIENT CONSENT TO PARTICIPATE

The study followed the tenets of the Declaration of Helsinki and was approved by the local ethical boards [USM/JEPeM/1907001]. Written informed consent for participation was obtained from each patient prior to the study.

## PATIENT CONSENT FOR PUBLICATION

Patient consent for publication was obtained during their participation.

## AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article. More details are available from the corresponding author upon request.

## ACKNOWLEDGMENT

The first author would like to thank all participants involved in this study.

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