

Socio-demographic factors modify awareness, knowledge, and perceived risk of glaucoma in rural and urban residents in Ghana: a population-based survey

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Abstract

Purpose: To evaluate the awareness, knowledge and the perception of risks of glaucoma among rural and urban dwellers in Ghana, a high prevalent country, in order to provide information for health promotion planning.

Method: In a population-based descriptive cross-sectional survey, 1200 adults were selected from household settings, using a two-stage cluster and simple systematic random sampling. Quantitative data collection, using interviewer-administered questionnaire, was employed. Descriptive statistics were performed using chi-square, ordinal univariate, multinomial and multivariate logistic regression models used to calculate odds ratio with 95% confidence interval (CI) to identify predictive factors.

Results: Overall, only 326 (27.2%, 95% CI = 24.6–29.7) indicated they were aware of glaucoma, whereas 331 (27.6%, 95% CI = 24.6–29.7) had ever undergone an eye screening. Low knowledge was demonstrated in 152 (46.6%, 95% CI = 41.2–52.0) and high knowledge in 99 (30.4%, 95% CI = 25.4–35.4) glaucoma-aware participants. Only 238 (19.8%, 95% CI = 17.6–22.1) of respondents presumed themselves to be at risk of developing glaucoma. Having eye examination (within the last 6 months) was positively associated with knowledge (adjusted odds ratio (AOR) = 1.413; 95% CI = 0.9–1.896) and awareness (AOR = 1.13; 95% CI = 0.938–2.449). Three levels of education (no education (AOR = 0.041; 95% CI = 0.016–0.11), primary (AOR = 0.057; 95% CI = 0.018–0.179), and middle school (AOR = 0.254; 95% CI = 0.127–0.51)) were associated with low knowledge while all levels of education were inversely associated with awareness. Perceived risk of glaucoma was also influenced by area of residence (rural (AOR = 0.344; 95% CI = 0.21–0.57)), being young (18–24 years (AOR = 4.308; 95% CI = 2.36–7.88)) and having previously undergone screening for glaucoma (AOR = 13.200; 95% CI = 5.318–32.764).

Conclusion: The main modifiers of glaucoma awareness and knowledge were education and previous eye examination, but awareness had additional factor of area of residence. Perceived risk of glaucoma was influenced by being young and living in urban areas.

Keywords: awareness, glaucoma, knowledge, perception, rural, socio-demographics, urban

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Introduction

Glaucoma is a term for a heterogeneous group of diseases with structural (optic disc damage) and functional loss (visual field loss).^{1,2} Conventionally,

glaucoma is classified broadly as angle-closure glaucoma (ACG) and open-angle glaucoma (OAG), with the latter being the most common type. Glaucoma is up to seven times more likely

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to be primary open-angle glaucoma (POAG) than angle-closure type.^{1,2} ACG is known to be highly prevalent among East Asians,³ whereas OAG is prevalent among Africans and people of African descent.^{4,5} POAG remains a major global public health problem despite available diagnostic measures. It is the main cause of irreversible blindness in developing nations, and it is estimated that over 76 million people worldwide have glaucoma,⁶ of which about 2.9 million people are blind.⁷

The relative prevalence of POAG differs according to ethnicity and age.^{4,6,8,9} Blacks are 4.3 times more likely to have glaucoma than Caucasians.^{4,10} Consequently, Africa is estimated to have the highest glaucoma prevalence of 4.79% as compared with 2.93% in Europe and 3.40% in Asia.^{5,6} Urban populations-based prevalence studies conducted in Ghana, West Africa, indicated a high glaucoma prevalence of 6.5–8.5%^{11–13} among persons aged 40 years or older.¹⁴ The current number of people affected by the disease in Ghana makes the country second highest with glaucoma cases worldwide,¹³ with an estimated 1 million blind.¹⁵ Despite these figures, reports suggest that glaucoma is undiagnosed in 9 of 10 affected people globally,¹⁶ indicating that about 90% of the affected people in the world are not aware they have the disease.¹⁶

Although glaucoma blindness is medically and surgically irremediable, early detection and treatment through strict control of intraocular pressure with anti-glaucoma drugs can minimise the effects of glaucoma. Unfortunately, POAG occurs almost without symptoms until the late stages of the disease. Thus, patients will only present for screening and possible treatment if they are aware that they are at risk. The main problem, however, appears to be that POAG in Africa often is detected only after much of the patient's visual function is irreversibly lost. In sub-Saharan West Africa, although the prevalence is known to be higher than in other regions in Africa, the disease is often neglected with devastating consequences.⁵ The level of awareness and knowledge of glaucoma among rural dwellers in West Africa have been found to be low in the population. In studies^{17,18} conducted in rural Nigeria, the awareness of glaucoma was found between 15.8%¹⁷ and 21.1.0%,¹⁸ whereas only 6.3% had good knowledge of the condition. The studies revealed that awareness of glaucoma was influenced by a range of psychological, economic, demographic and socio-cultural factors such as occupation, level of education, income, and previous eye examination, whereas income

and previous eye examinations predicted glaucoma knowledge.¹⁸ In Africa, although it is reported that the annual incidence in the region is conservatively estimated to be 400 new cases for every 1 million population, up to 75% of cases are detected in late stages as defined by absolute scotoma in the visual field.^{19–22} In this context, raising awareness of the disease is key for prevention, screening and effective management of glaucoma progression in the population. In this vein, failure to understand the local belief systems and superstitions may undermine efforts for early detection and management of the disease.²³ For instance, in Ghana, a qualitative study of glaucoma awareness showed that a public health presentation on glaucoma in the local dialect showed an extremely positive effect in the awareness of the disease in two communities.⁷ It is, therefore, important that factors that influence individuals' awareness and knowledge of their health risks are investigated in order to seek timely interventions for their illness.

This study compares the level of awareness, knowledge and subjective risk assessment of glaucoma among rural and urban dwellers in the Central Region of Ghana. The article highlights the sources of knowledge and analyses the socio-demographic characteristics of respondents that influence POAG awareness, knowledge and risk perception. Investigating how a local context modifies people's understanding of glaucoma can inform policy and public health interventions that will lead to early diagnosis and treatment of individuals with glaucoma in a highly prevalent country such as Ghana.

Methods

Study design

A population-based, descriptive cross-sectional survey was conducted by adhering to the tenets of the Declaration of Helsinki on Research involving human subjects. The study received approval from the Institutional Review Board of the University of Cape Coast with ethical clearance ID No: UCCIRB/CHAS/2017/47. All participants were fully informed about the nature of the questionnaire, and informed consent was obtained from respondents. Verbal consent was sought from opinion leaders of the communities where questionnaires were administered to respondents.

Setting

The Central Region,^{24,25} where this research was conducted, has a population of 2,201,863. With a

population density of about 162 inhabitants per square kilometres, the Central Region is the second most densely populated region after Greater Accra in Ghana. However, the proportion of the population in the region living in urban areas is 47.1%, which is below the national average of 50.9%, with the highest being 75.3% in Cape Coast area. There is a larger proportion of literate males (69.8%) than females (46.3%). The region is classified among the four poorest in the country. The region has a total of 17 public eye care facilities (12 of them Governmental and 5 by Christian Health Association of Ghana), 2 ophthalmologists, 36 optometrists and 47 ophthalmic nurses at the time of the study.

Study population and sample

A population-based survey was conducted in selected urban and rural areas in the Central Region of Ghana. The urban places chosen were within the most urbanised settlements within the Cape Coast Metropolis such as Abura, Kingsway and Kotokoraba with an estimated total population of 169,894. The rural settlements chosen were Esuehyia, Kormantse and Yamoransa with an estimated total population of 16,770.²⁵ The target population was adults aged 18 years and above. Although glaucoma is known to affect persons 30 years and above, the age range of study population was chosen to reflect the awareness and knowledge of glaucoma among the general population. Permanent residents (might have lived at least 6 months) in the study area were eligible to participate in the study, except eye care professionals and individuals who did not have the mental capacity or were seriously ill to answer the study questions who were excluded.

Sample size and sampling

The minimum sample sizes for the urban and rural population were 384 and 376, respectively, calculated based on the assumption that 50% of the population would be aware and have good knowledge of glaucoma. The following equation²⁶ was used

$$\text{sample size} = \frac{z^2 \times p(1-p)}{e^2} \div \left(1 + \frac{z^2 \times p(1-p)}{e^2 N} \right)$$

Where N = population size; p = the p-value, which is the expected prevalence or proportion; e

= Margin of error (percentage in decimal form); z = z-score. The z-score is the number of standard deviations a given proportion is away from the mean.

However, in order to minimise variability in the outcome measures and ensure adequate power throughout, the sample size was increased to a total of 1200 respondents, consisting of equal number of 600 rural and 600 urban dwellers. The larger sample size for the urban and rural populations was to obtain narrow intervals with high reliability and warrant meaningful comparison of the findings. The selection of respondents followed a two-stage sample design. The first stage involved selecting sample areas (clusters) consisting of complete list of households in the survey area delineated during the 2010 National Population and Housing Census.²⁵ A total of 44 clusters were selected, 24 in urban areas and 20 in rural areas. The second stage involved simple systematic random sampling of households. In the simple random sampling, up to about 27 households were randomly selected from each cluster until the desired sample size of 1200 was reached. Household sampling interval was determined by dividing the total number of households by the sample size. To reduce bias of household selection, the first house selected for each cluster sub-area was determined by a random method by assigning a number (1–2) to each interviewer and letting the interviewer select the first house on the basis of counting that number from the closest house to the drop-off point. The sampling interval was then used to select subsequent households. When households were visited, only one member of a household, usually someone nominated by the head or, in their absence, any member of the household, answered the questionnaire. The number of households included from each cluster was allocated proportional to size. If a house is unoccupied at the time of a visit, it was noted and revisited later that day or on another day. When it was noted that a house was permanently vacant, or when the occupants decline to participate, or if an adult was not available for interview after multiple attempts, then the next closest household was chosen for the interview. All men and women included in the survey were permanent residents of the selected household and therefore eligible to participate in the study.

Instruments used in data collection

We adopted a structured questionnaire to study the level of awareness, knowledge and perceived

risk about glaucoma, specifically POAG. The design of the questionnaire was based on a review of other related studies in similar settings.^{27–36} The questionnaire was constructed into four sections. In the first section (section A) of the questionnaire, individuals were asked about their socio-demographic data, including information about age, sex, education, occupation and marital status. In section B, we report on the outcome to questions which examined respondents' present awareness of glaucoma. Simple closed-questions such as 'Have you ever heard or do you know something about the eye disease called glaucoma or eye pressure (known in the local dialect as *Hunta fraye*,^{7,37} meaning a hidden or silent blinding condition)?' A participant was classified as being aware of glaucoma if a positive response ('yes') was indicated and also gave at least one of the following correct answers: 'glaucoma is high eye pressure', 'glaucoma is high eye pressure causing blindness', 'glaucoma causes damage to the eye nerve', blinding eye disease causing eye nerve damage, eye disease cause visual field loss.^{19,38,39} This definition was adopted because in previous studies conducted in Africa and during the pilot study, it was realised some participants may be aware of the term 'glaucoma', having heard about it in passing but were not aware of the condition or misconstrued it for another eye disease. There were follow-up questions in section 'C' to assess knowledge of glaucoma. A total of 13 questions were asked covering various aspects of glaucoma knowledge such as the causes, symptoms, treatment, duration of treatment, the effect of untreated glaucoma and whether glaucoma is hereditary. Respondents were said to have 'low knowledge' about glaucoma if they scored between 0% and 40% in this section, and respondents were said to have 'average knowledge' about glaucoma if they obtained a score of 45–70% in this section, and a score of 75–100% indicated 'high knowledge' about glaucoma. In the last part (section D), respondents' perception of glaucoma was assessed by asking whether they perceived themselves to be at risk of glaucoma, with follow-up closed-questions about risk factors associated with the disease. The questionnaire was developed in the English language but administered to respondents in English or in the local language, Fantse, based on the respondents' choice. Technical terms were translated into the local language for easy understanding. The questionnaire was subject to approval by experienced researchers involved in the study after a pilot study.

Data collection process and analysis

The questionnaires were interviewer-administered by two members of the team involved in the study after seeking consent from respondents. The data collection process took 3 months, from May to July 2018. The data obtained were entered into and analysed using the Statistical Package for Social Sciences (SPSS version 22). Simple descriptive and inferential statistics were used in analysing the following research questions:

- Is there a difference in the level of awareness of glaucoma between rural and urban dwellers in Ghana?
- Do socio-demographic factors (location, sex, age, education, and occupation) influence one's knowledge about glaucoma?

Descriptive statistics were used to describe the socio-demographic characteristics and associations between independent socio-demographic variables such as age, sex, location, educational level and type of occupation and dependent variables such as knowledge, awareness and the perception of risk of glaucoma tested using chi-square. Ordinal univariate, multivariate and multinomial logistic regression models and odds ratio with 95% CIs were used to identify factors predictive of awareness, knowledge and perception of risk of glaucoma. The p -value < 0.05 was considered statistically significant.

Results

Socio-demographic characteristics of respondents

A total of 1200 respondents participated in the study, consisting of 600 rural and 600 urban dwellers. Table 1 indicates the distribution of respondents' demographic data according to their residential statuses of rural or urban location. The majority of respondents were males (629 (52.4%)). Participants' ages ranged from 18 to 82 years, with a mean age of 32.71 ± 12.65 years. Overall, 870 (72.5%) of respondents were less than 40 years with the majority between 18 and 24 years (369 (30.8%)). The respondents had varying levels of educational attainment, but overall, the majority (311 (25.9%)) had achieved mid-level of education. Considerably, 273 (22.8%) of the total respondents had no education, of whom 178 (29.7%) were rural dwellers and 95 (15.9%) were from urban settings. The majority of respondents

Table 1. Frequency distribution of respondents socio-demographic background.

Variable	Rural	Urban	Total (%)
	Frequency (%)	Frequency (%)	
Sex			
Male	289 (48.2)	340 (56.7)	629 (52.4)
Female	311 (51.8)	260 (43.3)	571 (47.6)
Age category			
18–24	143 (23.8)	226 (37.7)	369 (30.8)
25–31	178 (29.7)	148 (24.7)	326 (27.2)
32–38	103 (17.2)	72 (12.0)	175 (14.6)
39–45	65 (10.8)	72 (12.0)	137 (11.4)
46–52	48 (8.0)	56 (9.3)	104 (8.7)
53–59	18 (3.0)	9 (1.5)	27 (2.3)
Above 60	45 (7.5)	17 (2.8)	62 (5.2)
Educational level			
No education	178 (29.7)	95 (15.8)	273 (22.8)
Primary	91 (15.2)	43 (7.2)	134 (11.2)
Middle school/Junior Secondary School	160 (26.7)	151 (25.2)	311 (25.9)
Secondary	89 (14.8)	165 (27.5)	254 (21.2)
Tech/vocational	49 (8.2)	47 (7.8)	96 (8.0)
Tertiary/postsecondary	33 (5.5)	99 (16.5)	132 (11.0)
Occupation			
Unemployment	89 (14.8)	26 (4.3)	115 (9.6)
Civil servant	50 (8.3)	97 (16.2)	147 (12.3)
Artisan	63 (10.5)	42 (7.0)	105 (8.8)
Trading	209 (34.8)	232 (38.7)	441 (36.8)
Fishing	21 (3.5)	2 (0.3)	23 (1.9)
Student	51 (8.5)	177 (29.5)	168 (14.0)
Farming	48 (8.0)	1 (0.2)	49 (4.1)
Commercial vehicle operator	69 (11.5)	79 (13.2)	148 (12.3)
Sports	0 (0.0)	4 (0.7)	4 (0.3)
Marital status			
Single	274 (45.7)	367 (62.7)	641 (53.4)
Cohabiting	63 (10.5)	40 (6.7)	103 (8.6)
Married	223 (37.2)	181 (30.2)	404 (33.7)
Divorced	20 (3.3)	6 (1.0)	26 (2.2)
Widowed	20 (3.3)	6 (1.0)	26 (2.2)
Total	600 (100)	600 (100)	1200 (100)

Table 2. Eye screening of respondents (N = 331).

Eye condition screened for	<6 months n (%)	Within 12 months n (%)	Within 24 months n (%)	>36 months n (%)	Total n (%)
Cataract	3 (6.3)	7 (6.1)	16 (18.6)	10 (12.2)	36 (10.9)
Glaucoma	0 (0.0)	5 (4.4)	0 (0.0)	1 (1.2)	6 (1.8)
Trachoma	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.3)
Refractive error	31 (64.6)	83 (72.2)	48 (55.8)	50 (61.0)	212 (64.1)
Other eye problems	14 (29.2)	20 (17.4)	21 (24.4)	21 (25.6)	76 (23.0)
Reason for eye screening					
No reason	0 (0.0)	1 (0.9)	1 (1.2)	0 (0.0)	2 (0.6)
Voluntary	46 (95.8)	101 (87.8)	69 (80.2)	62 (75.6)	278 (84.0)
Hospital protocol	2 (4.2)	7 (6.1)	6 (7.0)	11 (13.4)	26 (7.9)
Referral	0 (0.0)	3 (2.6)	10 (11.6)	2 (2.4)	15 (4.5)
Other reason	0 (0.0)	3 (2.6)	0 (0.0)	7 (8.5)	10 (3.0)
Place of eye screening					
Government hosp./clinic	27 (56.3)	71 (61.7)	47 (54.7)	47 (51.3)	192 (58.0)
Private hosp./clinic	6 (12.5)	26 (22.6)	6 (7.0)	17 (20.7)	55 (16.6)
Outreach	15 (31.3)	18 (15.7)	33 (38.4)	18 (22.0)	84 (25.4)
Total	48 (100)	115 (100)	86 (100)	82 (100)	331 (100)

were traders (441 (36.8%)), followed by students, most of whom were from urban areas (117 (29.5%)) than rural areas (51 (8.5%)).

Eye screening of respondents (N = 331)

Of the 1200 respondents, only 331 (27.6%) indicated they had ever undergone an eye screening, with most (192 (58.0%)) of the examinations taking place in a government facility or during an eye outreach programme 84 (25.4%). A substantial proportion (115 (34.7%)) of those who had ever checked their eyes happened within the last 12 months. Table 2 indicates the previous eye checking history among respondents.

Awareness and sources of information about glaucoma

Table 3 provides the distribution of respondents according to their awareness of glaucoma. Overall,

of the 1200 respondents, only 326 (27.2%; 95% CI = 24.6–29.7) indicated they had heard of glaucoma or knew something about it. The majority were urban residents (225 (18.8%; 95% CI = 16.5–21.0)). By proportion, those within the age at risk of glaucoma (>39 years) were less likely to be aware of glaucoma (0.6–2.6%) compared with the younger age group (18–24 years) who had a relatively higher proportion of their participants being aware of glaucoma. Follow-up questions which were used to compute the level of awareness of glaucoma is shown in Figure 1. The main sources of information regarding glaucoma awareness are presented in Figure 2. Mass media and health workers were the major sources of information for the two groups. Of the 326 respondents who had heard about glaucoma, more than two-third (250 (76.7%)) reported that the mass media were their main source of information about glaucoma, whereas 50 (15.3%) confirmed that a health worker was their main source

Table 3. Awareness of glaucoma across socio-demographic characteristics of respondents.

Characteristics	Total	Yes	No		χ^2/p -value	
	N (%)	n (%)	95% CI	n (%)		95% CI
Area of residence						
Rural	600 (50.0)	101 (8.4)	6.8 to 10.0	499 (41.6)	38.8 to 44.4	64.758/0.000
Urban	600 (50.0)	225 (18.8)	16.5 to 21.0	375 (31.3)	28.6 to 33.9	
Sex						
Female	571 (47.6)	147 (12.3)	10.4 to 14.1	424 (35.3)	32.6 to 38.0	1.114/0.291
Male	629 (52.4)	179 (14.9)	12.9 to 16.9	450 (37.5)	34.8 to 40.2	
Age category						
18–24	369 (30.8)	143 (11.9)	10.1 to 13.7	226 (18.8)	16.6 to 21.0	42.498/0.000
25–31	325 (27.1)	85 (7.1)	5.6 to 8.5	240 (20.0)	17.7 to 22.3	
32–38	178 (14.8)	31 (2.6)	1.7 to 3.5	147 (12.3)	10.4 to 14.1	
39–45	138 (11.5)	24 (2.0)	1.2 to 2.8	114 (9.5)	7.8 to 11.2	
46–52	100 (8.3)	22 (1.8)	1.1 to 2.6	78 (6.5)	5.1 to 7.9	
53–59	28 (2.3)	7 (0.6)	0.2 to 1.0	21 (1.8)	1.0 to 2.5	
Above 60	62 (5.2)	14 (1.2)	0.6 to 1.8	48 (4.0)	2.9 to 5.1	
Educational level						
No school	273 (22.8)	11 (0.9)	0.4 to 1.5	262 (21.8)	19.5 to 24.2	427.87/0.000
Primary	134 (11.2)	12 (1.0)	0.4 to 1.6	122 (10.2)	8.5 to 11.9	
Middle school/junior high	311 (25.9)	51 (4.3)	3.1 to 5.4	260 (21.7)	19.3 to 24.0	
Senior high	254 (21.2)	107 (8.9)	7.3 to 10.5	147 (12.3)	10.4 to 14.1	
Technical/vocational	96 (8.0)	23 (1.9)	1.1 to 2.7	73 (6.1)	4.7 to 7.4	
Tertiary/postsecondary	132 (11.0)	122 (10.2)	8.5 to 11.9	10 (0.8)	0.3 to 1.3	
Occupation						
Unemployed	115 (9.6)	21 (1.8)	1.0 to 2.5	94 (7.8)	6.3 to 9.4	215.46/0.000
Civil servant	147 (12.3)	91 (7.6)	6.1 to 9.1	56 (4.7)	3.5 to 5.9	
Artisan	105 (8.8)	25 (2.1)	1.3 to 2.9	80 (6.7)	5.3 to 8.1	
Trader	441 (36.8)	90 (7.5)	6.0 to 9.0	351 (29.3)	26.7 to 31.8	
Fisherman	23 (1.9)	1 (0.1)	–0.1 to 0.2	22 (1.8)	1.1 to 2.6	
Student	168 (14.0)	88 (7.3)	5.9 to 8.8	80 (6.7)	5.3 to 8.1	
Farmer	49 (4.1)	1 (0.1)	–0.1 to 0.2	48 (4.0)	2.9 to 5.1	
Commercial vehicle operator	148 (12.3)	9 (0.8)	0.3 to 1.2	139 (11.6)	9.8 to 13.4	
Sports	4 (0.3)	0 (0.0)	0.0 to 0.0	4 (0.3)	0.0 to 0.7	
Total	1200 (100.0)	326 (27.2)	24.6 to 29.7	874 (72.8)	70.3 to 75.4	

(Continued)

Table 3. (Continued)

Characteristics	Total	Yes	No		χ^2/p -value	
	N (%)	n (%)	95% CI	n (%)		95% CI
Previous eye screened						
No	868 (72.3)	142 (11.8)	10.0 to 13.7	726 (60.5)	57.7 to 63.3	185.19/0.000
Yes	332 (27.7)	184 (15.3)	13.3 to 17.4	148 (12.3)	10.5 to 14.2	
Total	1200 (100.0)	326 (27.2)	24.6 to 29.7	874 (72.8)	70.3 to 75.4	
Last time of eye screening						
Within 6 months	48 (14.5)	18 (5.4)	3.0 to 7.9	30 (9.1)	6.0 to 12.2	28.068/0.000
Within 12 months	115 (34.7)	77 (23.3)	18.7 to 27.8	38 (11.5)	8.0 to 14.9	
Within 24 months	86 (26.0)	33 (10.0)	6.7 to 13.2	53 (16.0)	12.1 to 20.0	
Over 36 months	82 (24.8)	56 (16.9)	12.9 to 21.0	26 (7.9)	5.0 to 10.8	
Total	331 (100.0)	184 (55.6)	50.2 to 60.9	147 (44.4)	39.1 to 49.8	

CI, confidence interval.

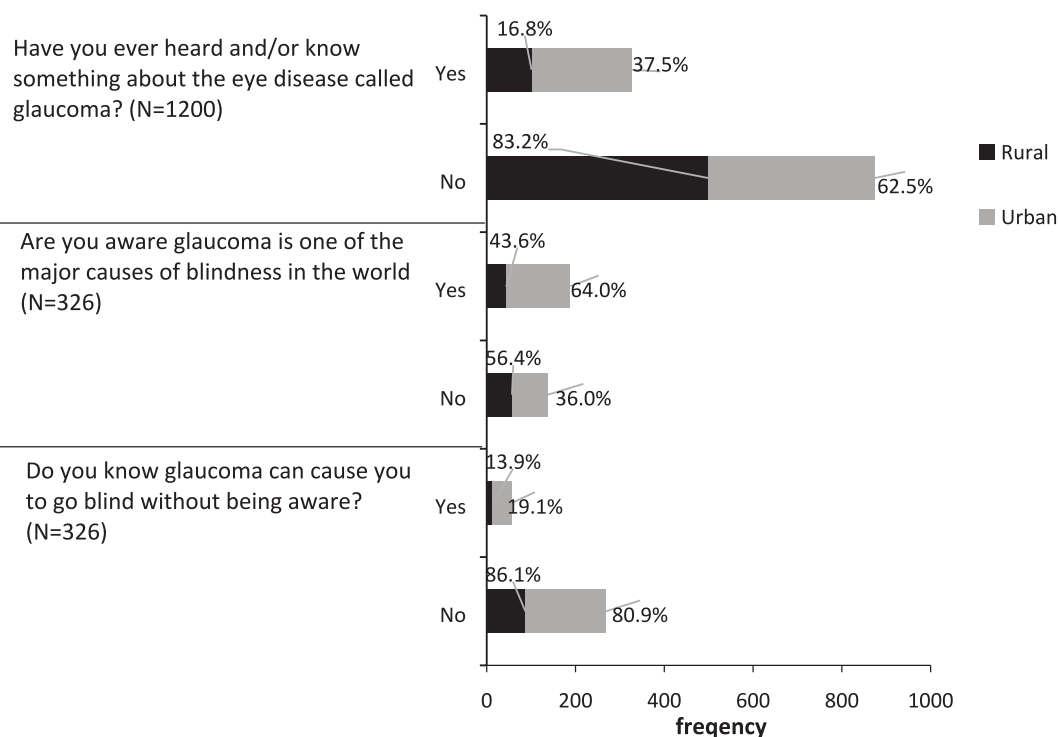


Figure 1. Participants' responses to a series of questions which examined their level of awareness of glaucoma. The results indicated that participants from urban settlements showed a greater awareness of glaucoma than in the rural areas.

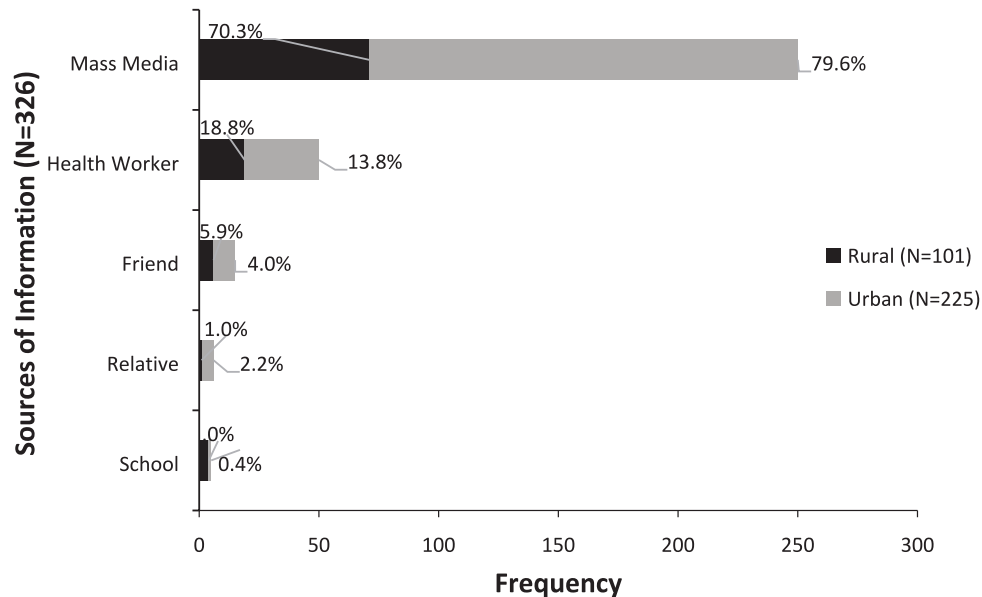


Figure 2. Bar graph showing the distribution of the main sources of glaucoma awareness among 326 respondents who were aware of glaucoma out of the total of 1200 respondents.

of information about glaucoma. Chi-square test showed that all selected socio-demographic factors (except sex) were associated with awareness (all $p < 0.001$) (Table 3), but having an eye examination within the last 6 months (adjusted odds ratio (AOR) = 1.13; 95% CI = 0.938–2.449) was predictive of awareness, whereas rural residence (AOR = 0.543; 95% CI = 0.278–1.061), lower level of education and ‘not having a previous eye checkup’ (crude odds ratio (COR) = 0.157; 95% CI = 0.119–0.208) were inversely associated with awareness (Table 4).

Assessment knowledge of glaucoma

Overall, low knowledge was demonstrated in 152 (46.6%, 95% CI = 41.2–52.0), moderate knowledge in 75 (23.0%, 95% CI = 18.4–27.6) and high knowledge in 99 (30.4%, 95% CI = 25.4–35.4) glaucoma-aware participants. There were relatively more rural (51 (50.5%)) than urban (101 (44.9%)) residents who had low knowledge of glaucoma (Appendix 1). A chi-square test showed that all considered socio-demographic characteristics were associated with knowledge except sex (all $p < 0.05$). However, ordinal univariate and multivariate regression analysis revealed that having eye examination within the last 6 months (AOR = 1.413; 95% CI = 0.9–1.896) was passively modified by knowledge, whereas three levels of education (no education (AOR = 0.041; 95% CI = 0.016–0.11), primary (AOR = 0.057;

95% CI = 0.018–0.179) and middle school (AOR = 0.254; 95% CI = 0.127–0.51)) were associated with low knowledge (Table 4).

Perception of risk of glaucoma

All the respondents were asked whether they perceived themselves to be at risk of developing glaucoma. Of the 1200 respondents, only 238 (19.8%) assumed that they may be at risk of developing glaucoma, whereas 459 (38.3%) respondents did not perceive themselves to be at risk (Appendix 2). Among those aware of glaucoma (326), majority (215 (90.3%; 86.6–94.1)) affirmed that they stood at risk of developing ($p \leq 0.001$). Follow-up questions were asked to evaluate the respondents’ perception of the important risk factors for glaucoma. Of the 623 respondents, only 93 (15.0%) recognised age as a risk factor, 18 (2.9%) perceived sex, 172 (27.6%) perceived ethnic background (African) and 112 (18.0%) perceived family history of glaucoma as the important risk factor (Figure 3). A multinomial logistic regression model (Table 5) showed that perceived risk of glaucoma was influenced by area of residence (rural (AOR = 0.344; 95% CI = 0.21–0.57)) and being young (18–24 years (AOR = 4.308; 95% CI = 2.4–7.9), 25–31 years (2.043; 95% CI = 1.24–3.38)), previous screening for glaucoma (AOR = 13.20; 95% CI = 5.32–32.76) and eye check within the last 3 years (within 6 months (AOR = 2.58; 95% CI = 1.302–3.128), within 12 months (AOR = 2.59;

Table 4. Univariate and multivariate ordinal regression of factors associated with awareness and knowledge of glaucoma among glaucoma aware respondents.

Characteristic	Knowledge				Awareness			
	Sig	Crude OR (95% CI)	Sig	Adjusted OR (96% CI)	Crude OR (95% CI)	Sig	Adjusted OR (95% CI)	
Residence								
Rural	0.000	0.36 (0.28–0.47)	0.599	1.14 (0.70–1.85)	0.00	0.34 (0.26–0.44)	0.045	0.54 (0.28–1.06)
Urban		1		1		1		1
Age								
18–24	0.011	2.23 (1.20–4.13)	0.763	0.83 (0.33–2.25)	0.016	2.17 (1.15–4.08)	0.677	1.48 (0.24–9.29)
25–31	0.788	1.09 (0.58–2.06)	0.873	0.93 (0.36–2.38)	0.555	1.214 (0.64–2.31)	0.290	2.42 (0.47–12.5)
32–38	0.322	0.70 (0.35–1.41)	0.592	0.73 (0.24–2.28)	0.371	0.72 (0.36–1.47)	0.456	1.85 (0.37–9.32)
39–45	0.278	0.67 (0.32–1.39)	0.064	0.38 (0.14–1.06)	0.388	0.72 (0.34–1.51)	0.056	0.24 (0.06–1.04)
46–52	0.927	0.97 (0.46–2.03)	0.344	1.65 (0.59–4.63)	0.931	0.97 (0.45–2.07)	0.695	1.32 (0.33–5.39)
53–59	0.943	1.04 (0.37–2.93)	0.989	1.01 (0.27–3.79)	0.802	1.14 (0.40–3.24)	0.545	1.64 (0.33–8.04)
Above 60		1		1		1		1
Education								
No School	0.00	0.02 (0.01–0.04)	0.000	0.04 (0.02–0.11)	0.000	0.00 (0.00–0.01)	0.000	0.01 (0.001–0.02)
Primary	0.00	0.05 (0.03–0.10)	0.000	0.06 (0.02–0.18)	0.000	0.01 (0.00–0.02)	0.000	0.01 (0.001–0.03)
Middle school/junior high	0.00	0.10 (0.07–0.2)	0.000	0.25 (0.13–0.51)	0.000	0.02 (0.01–0.03)	0.000	0.03 (0.01–0.09)
Senior high	0.00	0.47 (0.32–0.70)	0.171	0.64 (0.34–1.21)	0.000	0.06 (0.03–0.12)	0.000	0.04 (0.01–0.15)
Technical/vocational	0.00	0.17 (0.10–0.29)	0.802	1.15 (0.39–3.44)	0.000	0.03 (0.01–0.06)	0.004	0.08 (0.02–0.46)
Tertiary/postsecondary		1		1		1		1
Marital status								
Single	–	–	–	–	0.107	2.26 (0.84–6.06)	0.634	0.59 (0.07–5.15)
Cohabiting	–	–	–	–	0.134	0.40 (0.12–1.32)	0.918	1.14 (0.09–14.51)
Married	–	–	–	–	0.872	1.09 (0.40–2.97)	0.783	0.76 (0.13–4.76)
Divorced/separated	–	–	–	–	1	1.00 (0.25–3.97)	0.892	1.16 (0.14–9.91)
Widowed	–	–	–	–		1		1
Previous eye examination								
No	0.00	0.22 (0.17–0.29)		1	0.000	0.16 (0.12–0.21)		1
Yes		1				1		
Last eye examination								
Within 6 months	0.003	0.35 (0.18–0.70)	0.025	1.41 (0.09–1.90)	0.001	1.28 (0.93–2.59)	0.001	1.13 (0.94–2.45)
Within 12 months	0.869	0.96 (0.57–1.60)	0.813	0.94 (0.54–1.63)	0.844	0.94 (0.51–1.73)	0.442	0.72 (0.31–1.67)
Within 24 months	0.003	0.42 (0.24–0.75)	0.239	0.68 (0.36–1.29)	0.000	0.29 (0.15–0.55)	0.114	0.51 (0.22–1.18)
Over 36 months		1		1		1		1

CI, confidence interval; OR, odds ratio; 1, reference.

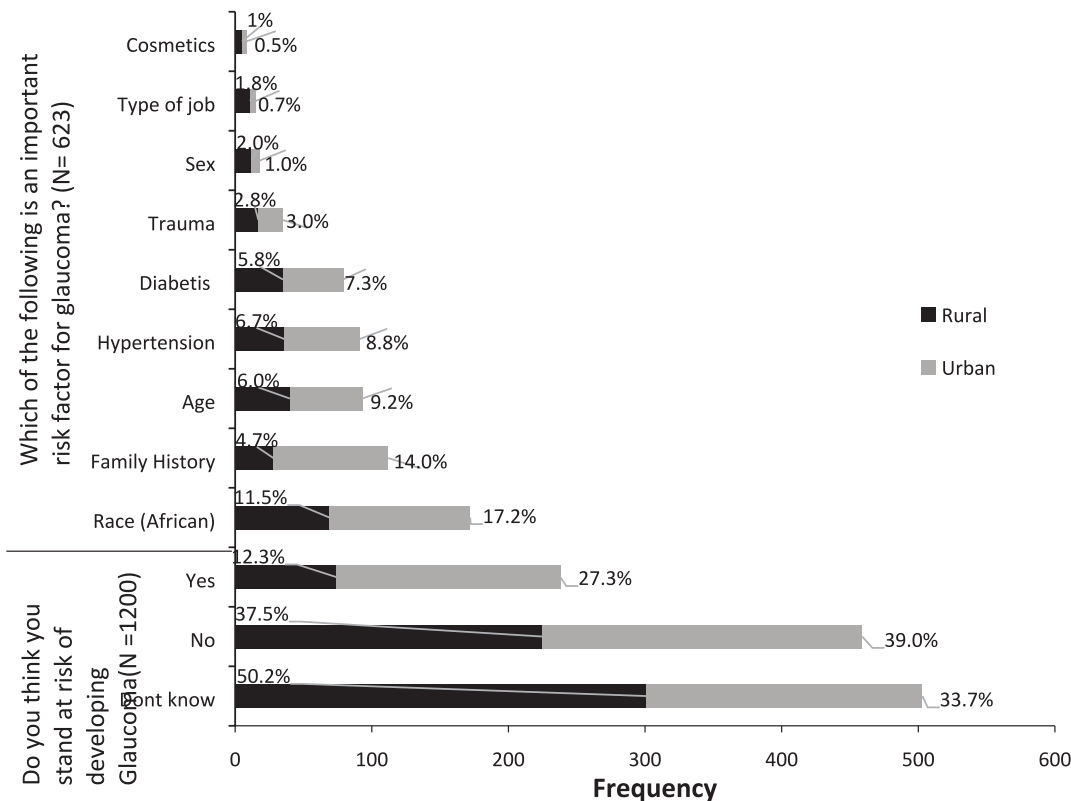


Figure 3. Respondents' perception of personal risk of developing glaucoma and important risk factors for developing glaucoma as identified by the participants.

95% CI = 0.66–4.04), within 24 months (AOR = 1.43; 95% CI = 1.25–2.74) and within the last 36 months (2.55; 95% CI = 1.52–4.28)).

Discussion

Glaucoma is a major public health challenge in many developing countries, especially in Africa, but the awareness and knowledge level of the condition remain largely undetermined. Only a few studies^{18–21,27–30} have been undertaken among known ophthalmic patients, urban population and health personnel to assess awareness level, obtaining results which are not reflective of the diverse nature of the general population. This study compared the level of awareness, knowledge and subjective risk evaluation of glaucoma in rural and urban localities of the Central Region of Ghana.

The demographic profile of respondents in this study largely reflects that of the Central Region and to a large extent Ghana. The greater number of males than females found in this study may be

due to the random nature of selecting respondents which were skewed towards male respondents in urban areas. In most African family settings, household heads are mostly males. In addition, there is a known migration of males than females from rural areas to more urban centres in Ghana due to economic pull factors. In addition, the age distribution of respondents depicts a youthful, but growing population, consistent with the population growth trend in many developing countries. Approximately 79.6% of Ghana's populations are younger than 40 years and 57% are younger than 25 years. The median age in Ghana is 21.5 years.²⁵ The age structure closely mirrors that of a population pyramid, indicating a broad base gradually tapering off at the older ages.

Nearly a quarter (22.8%) of the study population had never had a formal education. Comparatively, according to the Ghana Statistical Service,²⁵ in the Central Regional, about one in five (19.1%) have no formal education. We also found substantial differences between urban and rural dwellers

Table 5. A multinomial logistic regression analysis of risk factors for glaucoma among respondents.

Variable	No				Yes			
	Adjusted OR		Crude OR		Adjusted OR		Crude OR	
	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)
Last time of eye screening								
Within 6 months	0.687	0.79 (0.24–2.53)	0.020	0.42 (0.20–0.87)	0.012	0.18 (0.05–0.68)	0.045	2.58 (1.30–3.13)
Within 12 months	0.917	1.06 (0.37–3.02)	0.183	0.67 (0.37–1.21)	0.961	0.97 (0.32–2.99)	0.000	2.59 (1.66–4.04)
Within 24 months	0.664	0.80 (0.29–2.18)	0.012	0.52 (0.32–0.87)	0.033	0.29 (0.09–0.90)	0.002	1.43 (1.25–2.74)
Over 36 months	0.732	0.82 (0.26–2.55)	0.111	0.55 (0.26–1.15)	0.492	1.49 (0.48–4.63)	0.000	2.55 (1.52–4.28)
Area of residence								
Rural	0.299	0.69 (0.34–1.39)	0.493	0.81 (0.43–1.50)	0.015	0.45 (0.23–0.86)	0.000	0.34 (0.21–0.57)
Urban			0.039	0.31 (0.10–0.94)			0.000	8.38 (4.72–14.90)
Age								
18–24	0.586	1.36 (0.45–4.05)	0.467	1.31 (0.64–2.69)	0.008	5.06 (1.53–16.71)	0.000	4.31 (2.36–7.88)
25–31	0.035	0.27 (0.08–0.91)	0.003	0.26 (0.11–0.64)	0.056	3.03 (0.97–9.42)	0.005	2.04 (1.24–3.37)
32–38	0.073	0.30 (0.08–1.12)	0.023	0.31 (0.11–0.85)	0.715	1.29 (0.33–5.155)	0.244	0.63 (0.28–1.38)
39–45	0.108	0.40 (0.13–1.22)	0.019	0.44 (0.23–0.88)	0.320	0.514 (0.138–1.910)	0.135	0.63 (0.34–1.16)
46–52	0.365	0.57 (0.17–1.92)	0.207	0.57 (0.24–1.36)	0.468	1.606 (0.447–5.775)	0.695	0.86 (0.40–1.85)
53–59	0.160	0.28 (0.05–1.64)	0.080	0.25 (0.53–1.18)	0.242	0.36 (0.064–2.003)	0.258	0.50 (0.15–1.66)
Above 60			0.695	0.86 (0.40–1.85)			0.207	0.57 (0.24–1.36)
Screened for glaucoma								
No	0.135	1.78 (0.84–3.81)	0.025	0.62 (0.41–0.94)	0.911	1.04 (0.051–2.11)	0.201	0.78 (0.53–1.15)
Yes	0.905	1.11 (0.19–6.46)	0.273	0.40 (0.08–2.06)	0.000	18.29 (5.77–57.98)	0.000	13.20 (5.32–32.76)
I don't know			0.002	0.46 (0.29–0.75)			0.357	0.83 (0.55–1.24)

CI, confidence interval; OR, odds ratio.

regarding levels of education. As observed in this study, the levels of education among persons in urban areas were higher than those in rural areas. The disparity between urban and rural dwellers education got wider with increasing level of education. This trend in education among the respondents is illustrative of a situation of increasing school attendance for urban dwellers.

The main finding of this survey is that awareness about glaucoma in the general population is relatively very poor. The majority of the respondents in this study, constituting over two-thirds, were not aware of glaucoma. The main modifiers of awareness were area of residence, educational level

and previous eye examination. Interestingly, this finding corresponds with the proportions that had ever had their eyes screened. More rural dwellers compared with urban dwellers did not know of the condition. Even among respondents who reported being aware of glaucoma, some were oblivious to the fact that glaucoma could cause blindness. A relatively very high number of respondents in this study were not aware of glaucoma, compared with those found in population surveys in Germany,³⁰ United States,^{31–32} and Australia.^{16,33} In the Germany study, more than half of the population studied had an active knowledge of what glaucoma was while two-thirds had a passive knowledge of the disease.³⁰ The proportion of adult patients and

from communities in the United States who had heard of glaucoma was 72%³¹ and 70–93%,³² respectively. In a survey of 3654 Australian adults aged 49 years and older, 93% of the adults were aware of glaucoma.¹⁶ The higher rates of awareness in more established societies maybe due to higher education among the studied population and also suggest that these countries have more established eye care systems where people can seek care, increased utilisation of eye care services, and better access to information than in developing countries.

Similar community surveys conducted in some developing countries show contrasting findings to those found in developed economies.^{3,23–24} In south-western Ethiopia, a very low (2.4%) glaucoma awareness was reported in participants who participated in an ophthalmic outreach programme.³⁴ Our results confirm a study carried in Abokobi, a peri-community of the Greater Accra region of Ghana.²³ In the Abokobi study, of a total of 300 respondents, 39.3% (37.5% in the urban population in this study) were aware of glaucoma. Another study conducted by Ntim-Amponsah and colleagues^{13,21} and Ghana Statistical Service²⁵ in Ghana showed that about 94% of people diagnosed with glaucoma were unaware that they had the disease prior to being diagnosed. Population-based studies in India found awareness to be between 2.3%¹⁰ and 32%.^{8,35,36}

Not surprisingly, this study found that the overall knowledge of respondents about glaucoma was also low. Studies in India^{8,10,36} revealed knowledge of glaucoma in the rural population was very poor compared with the urban populations. Although we found a similar trend regarding awareness, in contrast to the studies conducted in India, this study showed that living in rural or urban setting was not predictive of glaucoma knowledge. Rather, respondents' level of education and previous history of eye examination modified their knowledge. There was not much difference in the responses of either sex, as sex practically did not influence knowledge. Age, area of residence, and occupation were also not predictive of glaucoma knowledge. Knowledge scores were associated with highly educated individuals and decreased with less educated individuals consistent with a previous study in Ghana.³⁷ Respondents who had no schooling or completed up to middle level of education were significantly associated with low glaucoma knowledge. Similar findings were reported in south-western Ethiopia³⁸ where glaucoma knowledge was significantly

associated with attaining high school education or better in an outreach ophthalmic programme.

The awareness level of respondents influenced their perception about the risk of developing glaucoma. Participants who perceived themselves as being at risk of glaucoma comprised mostly those who were aware and knowledgeable about glaucoma. The proportion of respondents who perceived themselves as being at risk of glaucoma and demonstrated an adequate understanding of the risk factors was generally low. Living in an urban area, being young, previous eye check and previous screen for glaucoma were positively associated with perceived risk of glaucoma. Generally, it is known that being of African descent⁴ and, especially, being older than 40 years are considered major risk factors for developing glaucoma, yet about 15% of respondents perceived age as the most important predisposing factor in POAG. More urban dwellers were inclined to believe that they could be predisposed to glaucoma, perhaps because they have access to more glaucoma educational campaigns and therefore are likely to seek health attention, in terms of screening. A study conducted in an²³ urban population in Ghana found that nearly half (49.7%) of the respondents perceived themselves to be at risk of developing glaucoma. The relatively higher perception scores observed among urban dwellers could be attributed to the higher educational attainment in the urban areas or could be due to the little or non-existent publicity about glaucoma in the rural communities.

The mass media and information from health personnel were indicated as the main source of information on the awareness and knowledge about glaucoma. This agrees with similar studies carried out in Ghana,^{21,23,37} Nigeria,^{17–18,27} and India^{8,36} where televisions and the radios were reported to be the main sources of information on glaucoma. As glaucoma is generally more prevalent in the aged, one would expect relatively high knowledge among them. The low level of glaucoma awareness in the rural population could be because rural dwellers are not more abreast with the use of modern technologies such as smartphones, computer, internet, and social media which are mostly media through which information could be broadcast to a larger number of people.^{37,38,40} Again, urban literacy rates are higher than rural literacy, but the real and opportunity costs of education are also relatively higher in rural communities. Because the bulk of glaucoma information and advocacy information are available

in print and on the internet, it is no surprise that more urban than rural and only about one-quarter had heard about glaucoma. It was also not surprising that risk perception of glaucoma was positively influenced by younger age. Boadi-Kusi and colleagues²² in a study among Health Science undergraduate students in Ghana found that written materials were the main source of information on glaucoma awareness and knowledge. The finding in this study, however, suggests that voice media are useful tools in disseminating public health education and promotion messages in low-resource settings. This implies that increasing investment in health education and promotion, especially in rural communities, needs to be done to address the many obstacles which militate against the uptake of health services.

Generally, reports indicate that there is low uptake of health services despite the introduction of the National Health Insurance Scheme (NHIS) to address funding and cost challenges. For instance, outpatient attendance in the Central Region is reported to have continued to show no improvement in spite of the coming into force of the NHIS. Attendance per capital has remained at 0.50. Moreover, lack of access to ophthalmic services may have contributed to the low levels of glaucoma awareness in rural areas, as only slightly more than a quarter (27.6%) had previously screened their eyes.³⁹⁻⁴¹

Our study suggests that more educational campaigns targeting individuals, community leaders, and gatekeepers about the insidious nature of the disease will probably have some effects. Such health campaigns should encourage people in the community to undertake eye screening which may help identify those who otherwise are not aware or unwilling to seek care and those at risk of the disease progression. More education about glaucoma may lead to a demand for more screening and possible treatment. In high-income countries, most glaucoma is detected opportunistically when individuals attend eye care for ophthalmic services. That said, improving access to ophthalmic services, which involves examination of the optic disc and IOP measurement as part of routine care, is recommended as a mechanism for early detection. This should also happen when adults attend eye clinics regardless of their presenting complaint. Although this study cannot prove that more awareness and knowledge will indeed lead to better eye care-seeking behaviour, timely information about glaucoma may contribute considerably to a better prognosis of the disease in Africa.

Strengths and limitations

Given the absence of previous studies that investigated the relative awareness, knowledge and self-perceived risk of glaucoma among rural and urban dwellers in a highly prevalent, but low-resource country like Ghana, the results of this study provide useful information that can assist in the development of policies and educational material on glaucoma for patients and their families.

First, recall bias is notable in studies that encompass some measure of self-reporting. The patients in this study were required to answer questions that entailed remembering past events, and as such, it is possible there might have been some inaccuracies in their recollections, especially with the older participants. Second, the selection of a household member nominated by the household head could have introduced some inherent bias as heads are likely to select the most perceived aware or knowledgeable individual in the household. However, in low-resource environments like Ghana, as is also the case in many other developing countries, families tend to rely on the most educated members when it comes to information on health and other related matters. On the contrary, as indicated, the demographic profile of respondents in this study largely reflected youthful population of the study area and to a large extent Ghana. Approximately 79.6% of Ghana's populations are younger than 40 years and 57% are younger than 25 years, with a median age of Ghana of 21.5 years. It is important that the awareness and knowledge of such individuals are assessed as it largely reflects the consciousness of the general population about a public health problem such as glaucoma. In assessing the awareness of glaucoma, the selection of household heads used in this study is particularly relevant because awareness campaigns about glaucoma are targeted towards groups that can have a significant impact on the incidence and glaucoma treatment programmes in a population.

Conclusion

This study found a low level of glaucoma awareness and knowledge among the study population, especially those with low level of education and no history of eye check. There was disparity in the perception of glaucoma risk among urban and rural dwellers with educational attainment, previous examination and being young as the major modifiers. The poor awareness of glaucoma, especially among rural residents, has the tendency to undermine public health programmes that seek to

reduce visual impairment and blindness. The right to health guarantees equal access to health; therefore, it is recommended that repeated educational services targeted at the elderly and are provided at rural areas to enhance access to healthcare services in order to ensure that all individuals irrespective of their location to benefit.

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Supplemental material

Supplemental material for this article is available online.

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Appendix 1

Knowledge of glaucoma across socio-demographic characteristics of respondents.

Characteristic	Total	Low		Moderate		High		χ^2/p -value
		n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Area of residence								
Rural	101 (31.0)	51 (15.6)	11.7 to 19.6	34 (10.4)	7.1 to 13.7	16 (4.9)	2.6 to 7.3	17.863/.000
Urban	225 (69.0)	101 (31.0)	26.0 to 36.0	41 (12.6)	9.0 to 16.2	83 (25.5)	20.7 to 30.2	
Sex								
Female	147 (45.1)	75 (23.0)	18.4 to 27.6	32 (9.8)	6.6 to 13.0	40 (12.3)	8.7 to 15.8	2.166/.339
Male	179 (54.9)	77 (23.6)	19.0 to 28.2	43 (13.2)	9.5 to 16.9	59 (18.1)	13.9 to 22.3	
Age category								
18–24	143 (43.9)	90 (27.6)	22.8 to 32.5	18 (5.5)	3.0 to 8.0	35 (10.7)	7.4 to 14.1	46.953/.000
25–31	85 (26.1)	23 (7.1)	4.3 to 9.8	24 (7.4)	4.5 to 10.2	38 (11.7)	8.2 to 15.1	
32–38	31 (9.5)	14 (4.3)	2.1 to 6.5	9 (2.8)	1.0 to 4.5	8 (2.5)	0.8 to 4.1	
39–45	24 (7.4)	6 (1.8)	0.4 to 3.3	7 (2.1)	0.6 to 3.7	11 (3.4)	1.4 to 5.3	
46–52	22 (6.7)	10 (3.1)	1.2 to 4.9	10 (3.1)	1.2 to 4.9	2 (0.6)	–0.2 to 1.5	
53–59	7 (2.1)	2 (0.6)	–0.2 to 1.5	2 (0.6)	–0.2 to 1.5	3 (0.9)	–0.1 to 2.0	
Above 60	14 (4.3)	7 (2.1)	0.6 to 3.7	5 (1.5)	0.2 to 2.9	2 (0.6)	–0.2 to 1.5	
Educational level								
No school	11 (3.4)	7 (2.1)	0.6 to 3.7	2 (0.6)	–0.2 to 1.5	2 (0.6)	–0.2 to 1.5	99.924/.000
Primary	12 (3.7)	10 (3.1)	1.2 to 4.9	1 (0.3)	–0.3 to 0.9	1 (0.3)	–0.3 to 0.9	
Middle school/junior high	51 (15.6)	23 (7.1)	4.3 to 9.8	16 (4.9)	2.6 to 7.3	12 (3.7)	1.6 to 5.7	
Senior high	107 (32.8)	75 (23.0)	18.4 to 27.6	25 (7.7)	4.8 to 10.6	7 (2.1)	0.6 to 3.7	
Technical/vocational	23 (7.1)	9 (2.8)	1.0 to 4.5	10 (3.1)	1.2 to 4.9	4 (1.2)	0.0 to 2.4	
Tertiary/postsecondary	122 (37.4)	28 (8.6)	5.5 to 11.6	21 (6.4)	3.8 to 9.1	73 (22.4)	17.9 to 26.9	
Occupation								
Unemployed	21 (6.4)	8 (2.5)	0.8 to 4.1	9 (2.8)	1.0 to 4.5	4 (1.2)	0.0 to 2.4	60.485/.000
Civil servant	91 (27.9)	24 (7.4)	4.5 to 10.2	25 (7.7)	4.8 to 10.6	42 (12.9)	9.2 to 16.5	
Artisan	25 (7.7)	10 (3.1)	1.2 to 4.9	8 (2.5)	0.8 to 4.1	7 (2.1)	0.6 to 3.7	
Trader	90 (27.6)	57 (17.5)	13.4 to 21.6	21 (6.4)	3.8 to 9.1	12 (3.7)	1.6 to 5.7	
Fisherman	1 (0.3)	0 (0.0)	0.0 to 0.0	1 (0.3)	–0.3 to 0.9	0 (0.0)	0.0 to 0.0	

(Continued)

Appendix 1. (Continued)

Characteristic	Total	Low		Moderate		High		χ^2/p -value
		n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Student	88 (27.0)	51 (15.6)	11.7 to 19.6	6 (1.8)	0.4 to 3.3	31 (9.5)	6.3 to 12.7	
Farmer	1 (0.3)	0 (0.0)	0.0 to 0.0	0 (0.0)	0.0 to 0.0	1 (0.3)	-0.3 to 0.9	
Commercial vehicle operator	9 (2.8)	2 (0.6)	-0.2 to 1.5	5 (1.5)	0.2 to 2.9	2 (0.6)	-0.2 to 1.5	
Previous eye screened								
No	142 (43.6)	96 (29.4)	24.5 to 34.4	31 (9.5)	6.3-12.7	15 (4.6)	2.3 to 6.9	56.396/.000
Yes	184 (56.4)	56 (17.2)	13.1 to 21.3	44 (13.5)	9.8-17.2	84 (25.8)	21.0 to 30.5	
Total	326 (100.0)	152 (46.6)	41.2 to 52.0	75 (23.0)	18.4-27.6	99 (30.4)	25.4 to 35.4	
Last time of eye screening								
Within 6 months	18 (9.8)	6 (3.3)	0.7 to 5.8	3 (1.6)	-0.2 to 3.5	9 (4.9)	1.8 to 8.0	7.163/.03
Within 12 months	77 (41.8)	21 (11.4)	6.8 to 16.0	17 (9.2)	5.1-13.4	39 (21.2)	15.3 to 27.1	
Within 24 months	33 (17.9)	15 (8.2)	4.2 to 12.1	9 (4.9)	1.8-8.0	9 (4.9)	1.8 to 8.0	
Over 36 months	56 (30.4)	14 (7.6)	3.8 to 11.4	15 (8.2)	4.2-12.1	27 (14.7)	9.6 to 19.8	
Total	184 (100.0)	56 (30.4)	23.8 to 37.1	44 (23.9)	17.7-30.1	84 (45.7)	38.5 to 52.8	

CI, confidence interval; 1, reference.

Appendix 2

Perception of risk of glaucoma across risk factors for glaucoma among respondents.

Variable	No		Yes		Don't know		χ^2/p -value
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Sex							
Female	223 (48.6)	44.0 to 53.2	98 (41.2)	34.9-47.4	250 (49.7)	45.3 to 54.1	5.006/0.082
Male	236 (51.4)	46.8 to 56.0	140 (58.8)	52.6-65.1	253 (50.3)	45.9 to 54.7	
Area of residence							
Rural	225 (49.0)	44.4 to 53.6	74 (31.1)	25.2-37.0	301 (59.8)	55.6 to 64.1	53.695/0.000
Urban	234 (51.0)	46.4 to 55.6	164 (68.9)	63.0-74.8	202 (40.2)	35.9 to 44.4	
Age category							
18-24	154 (33.6)	29.2 to 37.9	97 (40.8)	34.5-47.0	118 (23.5)	19.8 to 27.2	40.592/0.000
25-31	119 (25.9)	21.9 to 29.9	68 (28.6)	22.8-34.3	138 (27.4)	23.5 to 31.3	
32-38	67 (14.6)	11.4 to 17.8	17 (7.1)	3.9-10.4	94 (18.7)	15.3 to 22.1	
39-45	55 (12.0)	9.0 to 15.0	24 (10.1)	6.3-13.9	59 (11.7)	8.9 to 14.5	
46-52	29 (6.3)	4.1 to 8.5	19 (8.0)	4.5-11.4	52 (10.3)	7.7 to 13.0	
53-59	9 (2.0)	0.7 to 3.2	4 (1.7)	0.0-3.3	15 (3.0)	1.5 to 4.5	
Above 60	26 (5.7)	3.5 to 7.8	9 (3.8)	1.4-6.2	27 (5.4)	3.4 to 7.3	

(Continued)

Appendix2. (Continued)

Variable	No		Yes		Don't know		χ^2/p -value
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Have you ever gone for an eye screening?							
No	397 (86.5)	83.4 to 89.6	84 (35.3)	29.2–41.4	387 (76.9)	73.3 to 80.6	214.469/0.000
Yes	62 (13.5)	10.4 to 16.6	154 (64.7)	58.6–70.8	116 (23.1)	19.4 to 26.7	
Have you ever screened for Glaucoma?							
No	36 (58.1)	45.8 to 70.3	45 (29.2)	22.0–36.4	58 (50.4)	41.3 to 59.6	73.919/0.000
Yes	2 (3.2)	-1.2 to 7.6	66 (42.9)	35.0–50.7	5 (4.3)	0.6 to 8.1	
Don't know	24 (38.7)	26.6 to 50.8	43 (27.9)	20.8–35.0	52 (45.2)	36.1 to 54.3	
Last time of eye screening							
Within 6 months	10 (16.1)	7.0 to 25.3	14 (9.1)	4.6–13.6	24 (20.9)	13.4 to 28.3	45.056/0.000
Within 12 months	18 (29.0)	17.7 to 40.3	70 (45.5)	37.6–53.3	27 (23.5)	15.7 to 31.2	
Within 24 months	23 (37.1)	25.1 to 49.1	19 (12.3)	7.1–17.5	44 (38.3)	29.4 to 47.1	
Over 36 months	11 (17.7)	8.2 to 27.3	51 (33.1)	25.7–40.6	20 (17.4)	10.5 to 24.3	
Awareness of glaucoma							
No	405 (88.2)	85.3 to 91.2	23 (9.7)	5.9–13.4	446 (88.7)	85.9 to 91.4	598.753/0.000
Yes	54 (11.8)	8.8 to 14.7	215 (90.3)	86.6–94.1	57 (11.3)	8.6 to 14.1	
Knowledge level							
Low	44 (81.5)	6.9 to 12.3	64 (29.8)	21.3–32.5	44 (77.2)	6.3 to 11.2	85.167/0.000
Moderate	10 (18.5)	0.8 to 3.5	54 (25.1)	17.4–28.0	11 (19.3)	0.9 to 3.5	
High	0 (0.0)	0.0 to 0.0	97 (45.1)	34.5–47.0	2 (3.5)	-0.2 to 0.9	
CI, confidence interval.							