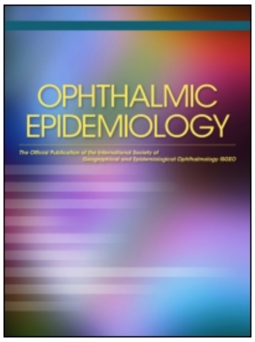

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ORIGINAL ARTICLE

Prevalence and Causes of Visual Impairment and Blindness among Cocoa Farmers in Ghana

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ABSTRACT

Purpose: To determine the prevalence and causes of visual impairment and blindness among cocoa farmers in Ghana in order to formulate early intervention strategies.

Methods: A cross-sectional study using multistage random sampling from four cocoa growing districts in Ghana was conducted from November 2013 to April 2014. A total of 512 cocoa farmers aged 40 years and older were interviewed and examined. The brief interview questionnaire was administered to elicit information on the demographics and socioeconomic details of participants. The examination included assessment of visual acuity (VA), retinoscopy, subjective refraction, direct ophthalmoscopy, slit-lamp biomicroscopy and intraocular pressure (IOP). For quality assurance, a random sample of cocoa farmers were selected and re-examined independently.

Results: Moderate to severe visual impairment (VA <6/18 to 3/60 in the better-seeing eye) was present in 89 participants (17.4%) and 27 (5.3%) were blind (presenting VA <3/60 in the better eye) defined using presenting VA. The main causes of visual impairment were cataract (45, 38.8%), uncorrected refractive error (42, 36.2%), posterior segment disorders (15, 12.9%), and corneal opacity (11, 9.5%).

Conclusion: The prevalence of visual impairment and blindness among cocoa farmers in Ghana is relatively high. The major causes of visual impairment and blindness are largely preventable or treatable, indicating the need for early eye care service interventions.

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Blindness; cataract; cocoa farmers; Ghana; uncorrected refractive error; visual impairment

Introduction

Agriculture is the backbone of most developing countries in Africa. In Ghana, cocoa farming provides employment for over 800,000 small households, and the industry serves as a major foreign exchange earner to the country providing an average of US$1.9 billion per year.[1] Good vision is important to accomplish tasks on the farm, and farmers depend on it for their activities such as harvesting from the top of a tree or reading chemical labels.[2–4] The nature of farming activities exposes farmers to higher risks of ocular injuries which may lead to visual impairment and blindness. Similarly, as noted by Davila and colleagues[5] "visual impairment among farmers could be caused by occupation-related increases in ocular disease risk factors (e.g. sun exposure) and eye injuries (e.g. exposure to chemicals, dust, radiation, welding, agricultural products, and penetration by foreign bodies)." Visual impairment among cocoa farmers could also be due to uncorrected refractive error which is common in farming populations.[6] The interventions needed to prevent visual impairment and blindness can significantly improve the quality of life and economic opportunities of the farmers. Despite the important role that cocoa farmers play in the economy of Ghana, there is no documented information on the prevalence and causes of visual impairment and blindness in the farming population. Therefore, there is a need for such studies to provide empirical evidence for formulating early effective intervention strategies. This study was conducted to investigate the prevalence and causes of visual impairment and blindness among cocoa farmers in Ghana.

Materials and methods

Sampling and sample size

A cross-sectional study was conducted among 512 cocoa farmers selected from four cocoa growing districts in Ghana, namely Juaboso (Western), Kwahu

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West (Eastern), Atwima Mponua (Ashanti) and Assin North (Central), using a multistage random sampling approach.[7] Ghana had a population of approximately 24.6 million in 2010[8] and cocoa production is focused nearly exclusively in the forest agro-ecological zones of six regions.[9] Following the selection of 20 villages from the four districts, societal heads and chief cocoa farmers in the selected villages assisted with the compilation of a list of all cocoa farmers in the villages to constitute a sampling frame out of which participants for the study were randomly selected. A proportion of the sample size was assigned to each village based on the population size of the settlement to give equal weighting.[7] As a result, an average of 25 participants was selected from each of the five villages in each district to constitute the study sample. The sample size for the study was determined by using the formula, $n = Z^2(1 - \alpha/_2)pq/d^2$ where $Z^2(1 - \alpha/_2) = 1.96$ at 95% confidence, $\alpha = 0.05$, p = prevalence of visual impairment, $q = 1 - p$ (i.e. $p = 0.1$ and $q = 0.9$), a precision (d) of ± 3% and design effect of 1.5. This gave a sample size of 576 cocoa farmers required.[10]

Inclusion and exclusion criteria

Farmers aged 40 years and older, engaged in production activities on a farm for a minimum period of 3 years (average gestation period for a cocoa tree) and having worked only on a cocoa farm were included in the study.

Procedures

Face-to-face interviews were conducted by three university graduate interviewers with relevant skills and experience in data collection. The questionnaire included issues on sociodemographic and farm characteristics of participants. The design of the questionnaire was based on a review of previous related studies.[11–13] Eye examinations were conducted by optometrists and an ophthalmologist. The interviewers and clinical staff underwent a 2-day training session. A pilot study was conducted in a cluster that was not part of the main study to identify and rectify any problems with implementation prior to undertaking the full study.

Clinical examination

A comprehensive clinical case history including personal and family ocular and medical histories was taken for all participants. Static visual acuity (VA) was measured monocularly, then binocularly under normal daylight illumination using a logarithm of the minimum angle of resolution (LogMAR) chart with tumbling "E" optotypes (Precision Vision, Villa Park, IL, USA) at 4 m and recorded as the smallest line at which at least four of the five optotypes were identified correctly. Pinhole VA was obtained for those participants whose VA was < 0.2 LogMAR. Near VA was measured monocularly and binocularly in ambient lighting conditions at 40 cm with (if used) and without near spectacles using a LogMAR near vision "E" chart (Precision Vision) and was recorded as per distance VA stated above. Refractive error was determined objectively with the use of a handheld retinoscope (EF 11710, Welch Allyn, Skaneateles Falls, NY, USA). Best-corrected VA with subjective refraction was determined using retinoscopic refraction measurements as a starting point. IOP was measured using a Perkins applanation tonometer (Haag Streit UK Limited, Harlow, UK). Two drops of 1% tropicamide were administered by an ophthalmologist 5 minutes apart, and after 20 minutes slitlamp biomicroscopy (SLM-3ER, Chongqing Kanghua, Chongqing, China) and direct monocular ophthalmoscopy (EF 11710, Welch Allyn) were performed following pupillary dilatation to detect the presence of ocular pathologies. Participants who needed further eye examinations or monitoring for any sight-threatening conditions were referred to the closest eye care facility for further ophthalmologic examination.

Definitions

The World Health Organization (WHO) definition of visual impairment which is based on presenting VA was used in this study.[14] Normal vision was defined as VA 6/18 (0.5 LogMAR) or better in the better eye, moderate to severe visual impairment was defined as VA<6/18 to 3/60 (1.3 LogMAR) in the better-seeing eye, i.e. moderate as VA <6/18 to 6/60 (1.0 LogMAR) and severe as VA <6/60 to 3/60, and blindness was defined as VA <3/60 in the better eye.[14,15] These definitions were applied in categorizing all measured habitual, as well as corrected VAs of participants. Near visual impairment was defined as the inability to read the 0.3 LogMAR line at 40 cm (N8).[16–19]

From the clinical procedures, diagnoses (a clinical impression) of all conditions identified among participants were made and used for computing causes of visual impairment among the study population.[20] Glaucoma was diagnosed based on IOP readings >21 mmHg and/or a vertical cup-to-disc ratio ≥0.7 and asymmetry ≥0.2 on ophthalmoscopy. Cataracts were defined as an opacity of the lens that led to visual impairment.[21] Posterior segment disorders as defined in this study included glaucoma, macular degeneration, hypertensive and diabetic retinopathy and retinal scars (presumed toxoplasmosis scarring).

Ethical considerations

Ethics clearance was obtained from the Ghana Health Service Ethics Committee on Research involving Human Subjects (GHS-ECRHS). Participants signed or thumb printed informed consent prior to data collection after the nature and purpose of the study were explained to them. Participants were assured that their data would be presented anonymously to protect their identity. The study was conducted according to the tenets of the Declaration of Helsinki on research regarding human subjects. Permission to conduct the study and work in the area was also sought and obtained from local leadership.

Data management and analysis

Data forms were reviewed for accuracy and completeness and then entered into Stata version 12 statistical software (StataCorp, College Station, TX, USA). Approximately 10% of records were randomly selected and re-captured and analyzed for any inconsistencies. Data were analyzed using descriptive statistics and frequencies presented with 95% confidence intervals (CIs). Pearson's Chi square or Fisher's exact test (whenever indicated) were used to determine the association between variables, with $p < 0.05$ reported as statistically significant. Where variables were not normally distributed, the Wilcoxon rank sum test was used and the median and inter-quartile range reported accordingly.

Quality assurance

Approximately 10% of participants in two clusters were subjected to independent re-evaluation of VA, objective (retinoscopy) and subjective refraction, IOP and major diagnoses. Findings by the original clinicians were not made known to the independent clinician. The final results from the designated independent clinician were compared with results from the original clinicians. There was an average correlation of 0.78 between the repeated measures (VA, r = 0.80; refractive error, r = 0.79; IOP, r = 0.76). The kappa statistics on major diagnoses were cataract ±κ = 0.78, uncorrected refractive error κ = 0.88, and posterior segment disorders κ = 0.84.

Results

Demographic and farm characteristics of participants

A total of 512 farmers of the 576 recruited completed the study, giving a response rate of 88%. Overall, 64.5% of participants were male and 35.5% were female, with a mean age of 56.7 ± 12.4 years. About one-quarter (26.0%) had no formal education. Males were more likely to be educated than females ($p < 0.001$). Similarly, more males were in the group with higher income than females ($p < 0.001$). Most participants had spent a greater part of their active years in cocoa farming (24.2 ± 12.4 years of farming), with males having 25.4 ± 12.7 mean years of farming compared to females of 21.9 ± 11.5 mean years ($p < 0.001$; Table 1).

Ocular and medical histories

The most common ocular complaint reported was poor distance vision ($n = 179$, 35.0%). Figure 1 shows the other commonly reported complaints by participants. Despite the numerous ocular complaints, 261 (51.0%) had never had an eye examination and only 128 (25.0%) reported having had an eye examination within the last year prior to the study. Similarly, 217 participants (42.4%) had never undergone any medical examination.

Visual impairment and blindness

The majority of participants had presenting (habitual) distance VAs of 0.5 LogMAR (6/18 Snellen) or better in right (396, 77.3%) and left (398, 77.7%) eyes. Approximately 72 (14.1%) and 64 (12.5%) had distance VA 6/18–6/60 in right and left eyes, respectively. The distribution of distance VA worse than 6/60 is also shown in Table 2. There was a moderate correlation between distance VA of right and left eyes of participants (Pearson's correlation coefficient, $r = 0.62$, $p < 0.001$).

Using the presenting VA of the better-seeing eye, moderate visual impairment was present in 13.9% of participants, while 3.5% had severe visual impairment and 5.3% were blind (Table 2). Using Best Corrected Visual Acuity (BCVA), the prevalence of visual impairment decreased from 17.4% to 8.8% (when defined using presenting VA). There was a statistically significant difference between males and females in the distribution of visual impairment, with males more likely to have visual impairment compared to females ($\chi^2 = 8.68$, $p = 0.038$). Similarly, prevalence of visual impairment increased with increasing age ($\chi^2 = 86.85$, $p < 0.001$). Most participants (88.9%, 95% CI 85.8–91.5%) were presbyopic based on their presenting near VA.

Causes of visual impairment

The causes of visual impairment were mainly cataract (45, 38.8%), uncorrected refractive error (42, 36.2%), posterior segment disorder (15, 12.9%) and corneal opacity due to trauma incurred on the farm (11, 9.5%; Table 3). Posterior segment disorders included

Table 1. Demographic and farm characteristics of cocoa farmers, Ghana.

Demographic characteristics	Male n = 330	Female n = 182	Total n = 512	p-value
Age group, n (%)				
40–49 years	85 (25.8)	48 (26.4)	133 (26.0)	0.901
50–59 years	115 (34.9)	66 (36.3)	181 (35.4)	
≥60 years	130 (39.4)	68 (37.4)	198 (38.7)	
Age, mean (SD) years	56.9 (12.7)	56.3 (11.5)	56.7 (12.4)	0.486
Education, n (%)				
No Education	63 (19.1)	70 (38.5)	133 (26.0)	<0.001
Primary	49 (14.9)	24 (13.2)	73 (14.3)	
Middle/junior high school	192 (58.2)	83 (45.6)	275 (53.7)	
Secondary/post-secondary	26 (7.9)	5 (2.8)	31 (6.1)	
Income, n (%)				
<5000 GHS	201 (60.9)	150 (82.4)	351 (68.6)	<0.001[a]
5000–9999 GHS	83 (25.2)	29 (15.9)	112 (21.9)	
10,000–14,999 GHS	28 (8.5)	2 (1.1)	30 (5.9)	
≥15,000 GHS	18 (5.5)	1 (0.6)	19 (3.7)	
Marital status, n (%)				
Never married	1 (0.3)	1 (0.4)	2 (0.4)	<0.001[a]
Married	245 (74.2)	83 (45.6)	328 (64.06)	
Living together	60 (18.2)	19 (10.4)	79 (15.4)	
Divorced	11 (3.3)	39 (21.4)	50 (9.8)	
Widowed	13 (3.9)	40 (22.0)	53 (10.4)	
Family size, n (%)				
>4 persons	4 (1.2)	10 (5.5)	14 (2.7)	<0.001
4–6 persons	95 (28.8)	69 (37.9)	164 (32.0)	
7–9 persons	124 (37.6)	80 (44.0)	204 (39.8)	
≥10 persons	107 (32.4)	23 (12.6)	130 (25.4)	
Farming duration, mean (SD) years	25.4 (12.7)	21.9 (11.5)	24.2 (12.4)	0.002
Farm size, median (IQR) acres	8 (5–15)	5.8 (3–9)	7 (4–12)	<0.001
Farming time, mean (SD) hours/week	35.5 (14.1)	29.4 (11.9)	33.4 (13.7)	<0.001

[a]Fisher's exact test.
GHS, Ghanaian Cedi (GHS1≈US$0.25); SD, standard deviation; IQR, interquartile range.

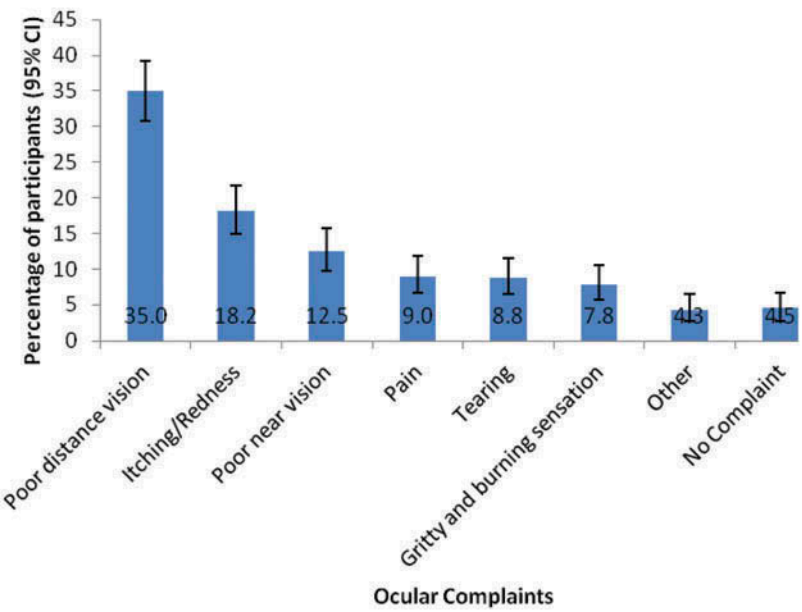

Figure 1. Ocular complaints reported by cocoa farmers in Ghana. CI, confidence interval.

glaucoma, macular degeneration, hypertensive retinopathy, diabetic retinopathy and retinal scarring. Corneal opacity and posterior segment disorders were more likely to cause visual impairment in men compared to women, and men were less likely to have cataract and uncorrected refractive error as a cause of visual impairment (χ^2 = 12.13, p = 0.034; Table 3).

Discussion

In this study, the prevalence and causes of visual impairment and blindness among cocoa farmers were determined because they are major contributors to the Ghanaian national economy. The working environment also exposes farmers to hazardous conditions which may lead to visual impairment and blindness, causing

Table 2. Presenting distance visual acuity in cocoa farmers, Ghana.

	Right eye		Left eye		Better-seeing eye	
Snellen visual acuity	Presenting VA, *n* (%)	Best-corrected VA, *n* (%)	Presenting VA, *n* (%)	Best-corrected VA, *n* (%)	Presenting VA, *n* (%)	Best-corrected VA, *n* (%)
≥6/18	396 (77.3)	439 (85.7)	398 (77.7)	440 (89.4)	398 (77.7)	443 (86.5)
<6/18–6/60	72 (14.1)	35 (6.8)	64 (12.5)	31 (6.1)	71 (13.9)	31 (6.1)
<6/60–3/60	18 (3.3)	14 (2.7)	23 (4.5)	16 (3.1)	18 (3.5)	14 (2.7)
<3/60	27 (5.3)	24 (4.7)	27 (5.3)	25 (4.9)	27 (5.3)	24 (4.7)
Total	512 (100.0)	512 (100.0)	512 (100.0)	512 (100.0)	512 (100.0)	512 (100.0)

Table 3. Distribution of causes of visual impairment by sex in cocoa farmers, Ghana.

Ocular condition	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)	*p*-value
Cataract	25 (35.2)	20 (44.4)	45 (38.8)	0.034[a]
Uncorrected refractive error	21 (29.6)	21 (46.7)	42 (36.2)	
Posterior segment disorder	12 (16.9)	3 (6.7)	15 (12.9)	
Corneal opacity	10 (14.1)	1 (2.2)	11 (9.5)	
Other	3 (4.2)	0 (0.0)	3 (2.6)	
Total	71(100)	45(100)	116 (100)	

[a]Fisher's exact test.

significant social and economic burdens to individuals, families and societies in general.[22] Given the paucity of data specifically focused on visual impairment and blindness in cocoa farmers, this research is necessary for planning effective strategies.

The main ocular complaints reported (Figure 1) suggest a poor state of vision in cocoa farmers. The frequency of symptoms reported by farmers was much higher than those reported by Ocansey and colleagues in a normal Ghanaian population.[23] Despite the numerous reported ocular complaints, one in every two participants had never had an eye examination. This is of concern since the mean age of farmers was 56.7 ± 12.4 years and aging is associated with an increased rate of visual impairment and eye diseases, some of which are potentially blinding. Eye health promotion campaigns are therefore needed to inform farmers about the importance of regular eye examinations and the implications of delayed eye care.

Visual impairment presents a significant impediment to task performance among any working population. This poses significant risks to cocoa farmers and their colleagues such as the risks of ocular injuries due to impaired vision. For example, although 5.3% of participants were legally blind, they continued to work on the farm. Most of the participants in this category admitted that they had challenges going to work and undertaking their tasks effectively. However, they reported that they were managing their way around the farm because they were familiar with their daily routine and working environment. Others indicated that they were no longer involved in the most strenuous activities on the farm. Irrespective of the coping mechanisms adopted by these participants, they present a considerable risk to themselves and their co-workers on the farm.

The prevalence of visual impairment and blindness found in this study is high. This could be mainly due to participants not seeking eye care services leading to visual impairment as a result of mainly avoidable and preventable causes. This view is supported by the fact that the main causes of visual impairment were cataract and uncorrected refractive error. Cataract can be managed through surgical intervention and uncorrected refractive error can be corrected. It is worth noting that substantial (more than half) improvement was seen in the VA of participants after refractive error correction. This gives credence to the fact that uncorrected refractive error remains the leading, and yet most preventable, cause of visual impairment.[15,24–27]

The prevalence of moderate-to-severe visual impairment was higher in this population than that reported for the West African sub-region (4.1%) by Naidoo and co-authors[26] and the 4.4% in older Ghanaian people.[27] However, the prevalence of visual impairment in this study was similar to the 17.1% finding in the Tema Eye Survey in Ghana.[25] This could be an indication that the burden of visual impairment remains a challenge in the Ghanaian population in general. The prevalence of blindness in our study, was however, higher than that in the Tema Eye Survey.[25] The high prevalence of posterior segment disorders is also of concern and confirms the assertion by Bastawrous and co-workers[28] who reported that aside from cataract, conditions such as glaucoma, macular degeneration, and diabetic and hypertensive retinopathies remain significant causes of visual impairment in Sub-Saharan Africa. Early diagnosis and management of these disorders can minimize the risk of visual impairment. It is also important to note that the prevalence of blindness in the current study population is higher than the national prevalence of 0.70% in Ghana,[29,30] the 4.4% moderate to severe bilateral blindness reported in people 40 years and older in the Volta Region of Ghana,[27] and the 1.2% blindness rate reported by Budenz and colleagues[25] in the Tema Eye Survey in Ghana. These results suggest the need for a concerted effort by stakeholders in the agricultural and health industries to address the eye care needs of the cocoa farming population who contribute greatly to the growth of the Ghanaian economy.

Our finding that males were more likely to be visually impaired than their female counterparts is similar to that reported by Budenz and co-authors[25] but differs from several other reports in the literature.[26,39,31–33] Our results could be due to sample variation as there were more males than females in our study population.

Corneal opacities due to injury found in this study could be a further reflection of the risks that farmers face. The prevalence of corneal opacities is higher than those reported in other African countries.[27,30,34,35] However, the variability in the study methods prevents direct comparison. Corneal opacities could be avoided if preventive measures such as the regular use of protective eye wear are adopted by farmers. The causes of visual impairment found in this study prompt the need for intervention strategies such as public health education programs to inform farmers about these causes and their implication for their health, as well as that of their co-workers. Such campaigns should highlight the fact that these causes are mainly avoidable, treatable or preventable, provided the appropriate health interventions are available, sought or provided.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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