British Journal of Medicine & Medical Research
15(1): 1-10, 2016, Article no.BJMMR.25261
ISSN: 2231-0614, NLM ID: 101570965

SCIENCEDOMAIN *international*
www.sciencedomain.org

Eye Care Practitioners' Perception of Oculomycosis in Ghana

Linda Gyanfosu[1,2], George Asumeng Koffuor[1*], Samuel Abokyi[3] and Ben Ababio-Danso[2]

[1]Department of Pharmacology, Faculty of Pharmacy and Pharmaceutical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
[2]St. Michael's Catholic Hospital, Pramso (Bosomtwi District), Ashanti Region, Ghana.
[3]Department of Optometry, School of Allied Health Sciences, College of Health and Allied Sciences, University of Cape Coast, Cape Coast, Ghana.

Authors' contributions

This work was carried out in collaboration between all authors. Authors GAK, SA and BAD designed, wrote the protocol and supervised the study. Author LG managed the literature searches, collected all data and wrote the first draft of the manuscript. Authors GAK, LG and SA analysed data obtained. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/25261
Editor(s):
(1) Barbara Giambene, Eye Clinic, Department of Translational Surgery and Medicine, University of Firenze, Italy.
Reviewers:
(1) Sagili Chandrasekhara Reddy, National Defence University of Malaysia, Malaysia.
(2) Vaishali Shah, P D Hinduja Hospital, Mumbai, India.
(3) Gabor Nemeth, Borsod-Abauj-Zemplen Country Hospital and University Teaching Hospital, Miskolc, Hungary.
(4) Amal R. Nimir, Cyberjaya University College of Medical Sciences, Malaysia.
Complete Peer review History: http://sciencedomain.org/review-history/14122

Original Research Article

Received 25th February 2016
Accepted 24th March 2016
Published 12th April 2016

ABSTRACT

Aims: Oculomycosis is a major cause of visual impairment and blindness in the tropical regions of the world. Practitioners' perception of the prevalence of oculomycosis and its associated risk factors could aid in the prevention of this ocular disorder. This study therefore investigated the eye care practitioner's perception of oculomycosis in Ghana.
Study Design: A cross-sectional survey.
Place and Duration of Study: Department of Pharmacology, Faculty of Pharmacy and Pharmaceutical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, between January and September, 2014.
Methodology: A cross-sectional survey of 120 eye care practitioners in six regions of Ghana was

**Corresponding author: E-mail: gkoffuor@yahoo.com, gakoffuor.pharm@knust.edu.gh*

conducted, using a structured questionnaire, to obtain information on their perception regarding the prevalence, seasonal variations and risk factors of oculomycosis.
Results: Optometrists, Ophthalmic nurses, and Ophthalmologists sampled were 43.3%, 42.5% and 14.2% respectively. More than one-third (39.2%) of the respondents reported that oculomycosis was commonly encountered in clinical practice, with the majority 66 (55.0%) stating that the prevalence was higher in April to November i.e. the planting and harvesting periods in the year. The practitioners' perception of the prevalence of oculomycosis showed strong association with their gender (P = .01), duration of practice (P = .01), profession (P = .05) and facility type (P = .03). Risk factors commonly associated with oculomycosis were trauma from vegetative matter (80%) and non-vegetative matter (50%) and the use of herbal preparations on the eye (41.7%).
Conclusion: Oculomycosis is a prevalent ocular condition encountered by eye care practitioners in Ghana, especially during the rainy season. Intensification of health education on its risk factors could help minimize or prevent occurrence of this ocular condition.

Keywords: Visual impairment; prevalence; Christian Health Association of Ghana (CHAG); oculomycosis.

1. INTRODUCTION

Oculomycosis (fungal infections of the eye) is a public health concern in developing countries, as well as in the tropical and subtropical regions of the world; accounting for more than 50% of all patients with culture-proven microbial keratitis, and being recognized as an important cause of visual impairment and blindness [1]. It is commonly caused by *Candida, Fusarium, Cephalosporium* and *Aspergillus spp* of fungi, and manifests itself mainly as exogenous or endogenous endophthalmitis and keratomycosis [2]. Oculomycosis is diagnosed based on the characteristic clinical presentation of corneal ulcer, as well as culture and sensitivity testing of specimen obtained by corneal scraping [3].

The incidence of oculomycosis in developed countries is low but is substantially high in developing countries [4] and may vary by geographical region [5], more specifically by latitudinal variation, local climate, extent of urbanization, occupational and/or economic factors [6]. The prevalence of oculomycosis as reported from different parts of the world, includes 44% and 37.6% from India [7] and Ghana respectively [8], 17% from Nepal [9], 36% from Bangladesh [10], 18.7% from Iraq [11] and 2% from USA [12]. Oculomycosis accounts for about 50% of corneal infections in other countries such as Burma [13], Paraguay [14], Thailand [15], and Turkey [16].

In the prevention or management of a disease or disorder, information concerning its prevalence and associated risk factors is of great value [17]. It helps in estimating the magnitude of the problem, and implementing appropriate measures to control it e.g. formulation of policies on the number and types of professionals needed, the required healthcare facilities (i.e., clinics and medical laboratories to aid in the diagnosis), and the medications needed to be stocked for treatment/management of the disease or disorder. Vision loss due to oculomycosis is more common in areas where there is limited access to eye care in terms of having assess to eye facilities, practitioners, and drugs.

Due to the devastating visual effect of oculomycosis, it is very necessary to put in frantic effort to decrease the incidence and prevalence, and manage effectively oculomycosis in developing countries. It is in this light that this study investigated the eye care practitioners' perception of prevalence, and associated risk factors of oculomycosis as a step towards preventing the devastating effect of this ocular condition, as well as to raise public awareness of the disease in Ghana.

2. METHODOLOGY

2.1 Ethical Consideration

Informed consent was obtained from all practitioners before participation in accordance with the tenets of Declaration of Helsinki regarding the use of human subjects for research. In addition, permission was obtained from the Head of each health facility used in this study.

2.2 Study Population

This study was conducted among eye care practitioners in six out of the ten regions in

Ghana. The selected regions were chosen based on their geographical distribution to ensure appropriate representation of participants across the country. Ghana was divided into three blocks and from each block two regions were selected. Thus the Southern block comprised Greater Accra and Central regions; the Middle block comprised Eastern and Ashanti regions, and the Northern block included Brong Ahafo and Northern regions. The study was conducted between January and September, 2014.

2.3 Sampling Size

The sample size for the survey was 120 (the minimum was estimated by Glenn's equation: $N_o=z^2pq/e^2$, Where N_o is Sample size, z^2 is the abscissa of the normal curve that cuts off an area α at the tails (1-α equals the desired confidence level, e.g. 95%), e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q equals to 1-p [18].

2.4 Sampling Technique

Cluster sampling was used in recruiting participants. First, each eye care facility in a specific region was further classified based on its location as rural (those located in districts areas) or urban (those located in metropolitan areas). For each region, two rural and three urban eye care facilities were randomly selected to participate in the study. A total of 30 facilities were selected from which participants were recruited. During a visit to any facility, any ophthalmologist, optometrist and ophthalmic nurse that was present and satisfied the inclusion criteria was recruited. The inclusion criteria for participants were: being a registered eye care practitioner in active practice, being involved in diagnosing and managing oculomycosis, and having had at least one year working experience. On the average, four (4) eye care practitioners were recruited from each facility. A total of 120 eye care participants were recruited from facilities including the Teaching hospitals, Government hospitals, Christian Health Association of Ghana (CHAG) hospitals, as well as hospitals owned by Non-Governmental Organizations (NGOs) or private individuals.

2.5 Study Design and Instrument for Data Collection

A cross-sectional survey of optometrists, ophthalmologists and ophthalmic nurses was conducted using structured questionnaire designed to cover the following: Bio-data of eye care practitioners, perception of prevalence of oculomycosis and associated risk factors. Questionnaires were self-administered by the practitioners within a time frame of 5 minutes. A pilot survey was first undertaken on 30 participants to test the reliability and validity of the test items. A Cronbach's alpha co-efficient of 0.82 was obtained.

2.6 Data Analysis

Data obtained was collated and analyzed using SPSS V 20 (SPSS, Chicago, Illinois, USA). Pearson's chi-square (χ^2) was used to show relationship between two categorical variables. $P \leq .05$ was considered significant. Sigma Plot V 11 (Systat Software, Inc., San Jose, CA) was used to plot graph.

3. RESULTS

3.1 Demographics of Eye Care Practitioners

Of the 120 practitioners recruited in this survey, 63 (52.5%) were males and 57 (47.5%) were females. Forty eight (40.0%) of the practitioners were aged 21-30 years with only 16 (13.3%) aged 50 years or older. The number of ophthalmologists were few 17 (14.2%) compared to optometrists 52 (43.3%) and ophthalmic nurses 51 (42.5%) in the sampled population. Regarding their professional practise, 68 (56.7%) had worked for at most 3 years, with 12 (10.0%) having worked for over 13 years (Table 1). Sixty two (51.7%) of the practitioners worked in health facilities located in the Districts, while 58 (48.3%) worked in those health facilities in the Metropolis. The practitioners were almost evenly distributed across the different types of eye care facilities in the country. Table 2 shows the distribution of the respondents by the location of facility and type of facility.

3.2 Prevalence and Seasonal Distribution of Oculomycosis

Oculomycosis was perceived by 47 (39.2%) of the practitioners as a relatively common ocular infection. Concerning the time of the year when the condition was much prevalent, 66 (55.0%) of the practitioners reported April to November (rainy season), while only a few suggested December to March (dry season) (Table 3).

Table 1. Demographic characteristics of eye care practitioners

		n	%
Gender	Female	57	47.5
	Male	63	52.5
Age	21-30	48	40.0
	31-40	35	29.2
	41-50	21	17.5
	51-60	16	13.3
Profession	Ophthalmologist	17	14.2
	Optometrist	52	43.3
	Ophthalmic Nurse	51	42.5
Duration of Practice	≤3 years	68	56.7
	4-8 years	18	15.0
	9-13 years	22	18.3
	>13 years	12	10.0

n = frequency

Table 2. Location of practice for practitioners interviewed

		n	%
Location	Metropolis	58	48.3
	Districts	62	51.7
Type of facility	Teaching Hospital	30	25.0
	Government Hospital	32	26.7
	CHAG Institution	33	27.5
	NGO/ Private	25	20.8

n= frequency; Christian Health Association of Ghana (CHAG); Non-Governmental Organization (NGO)

Table 3. Prevalence and seasonal distribution of oculomycosis as reported by eye care practitioners

		n	%
Prevalence	Common	47	39.2
	Uncommon	73	60.8
Season	April-November	66	55.0
	December-March	13	10.8
	All year round	41	34.2

n = frequency

3.3 Factors Associated with Practitioner's Perception of Prevalence of Oculomycosis

The factors significantly associated with the perception of oculomycosis as being a common ocular infection were: gender of respondent (*P* = .01), duration of practice (*P* = .01), type of facility (*P* = .03) and the type of profession (*P* = .05). A greater proportion of females 29 (50.9%) perceived oculomycosis as common than in the males 18 (28.6%) as shown in Fig. 1. In comparison with all the other age groups, those between 51 to 60 years had the majority of their respondents 9 (56.2%) perceiving oculomycosis as common (Fig. 2), although the association between age and perception was not significant (*P* = .45). Most of the practitioners working with CHAG facilities perceived oculomycosis as common (40.4%) compared to those in other facilities (Fig. 3). Also, a greater proportion of the practitioners who had practiced between 1-3 years and 4-8 years perceived oculomycosis as uncommon compared to those having a longer duration of practice (Fig. 4). The majority of ophthalmologist 11 (64.7%) perceived oculomycosis as common unlike the other two professionals (Fig. 5). While more practitioners located in the Districts perceived oculomycosis to be common than those in the Metropolis (Fig. 6), location of practice (i.e., Metropolis or District) was not associated with the perception of oculomycosis (*P* = .20).

3.4 Risk Factors Associated with Oculomycosis

Among the risk factors commonly associated with oculomycosis by practitioners were mainly trauma from either vegetative matter (80%) or non-vegetative matter (50%), and the use of herbs (41.7%) topically in managing other ocular infections (Fig. 7).

4. DISCUSSION

This study investigated eye care practitioner's perception of the prevalence of oculomycosis and its associated risk factors. The results show that more than one-third of the eye care practitioners perceived oculomycosis as a relatively common ocular infection. This perception of the eye care practitioners was associated with factors such as gender, duration of practice, type of facility and type of profession. In this study, the male-to-female ratio is almost unison, which augurs well for establishing relationship between gender and the practitioners' perceptions on oculomycosis. It has been previously reported that gender has an influence on the way of thought or perception [19]. This study supports this assertion as more than one-half of the female population (50.9%) suggested that oculomycosis was common compared to male population (28.6%).

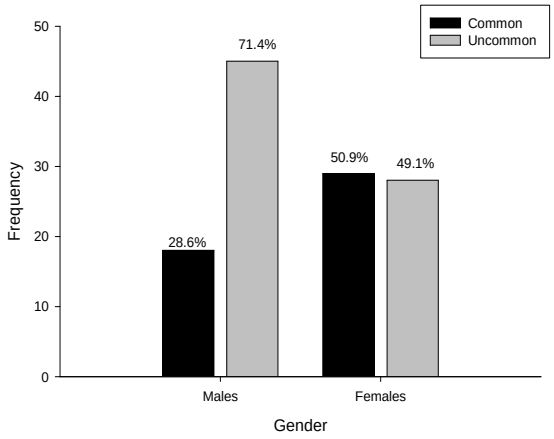

Fig. 1. The association between gender of eye care practitioners and perception of prevalence of oculomycosis

There was a significant difference (P = .01) between male eye care practitioners and their perceived perception of oculomycosis. (Pearson's Chi Square (χ^2) test)

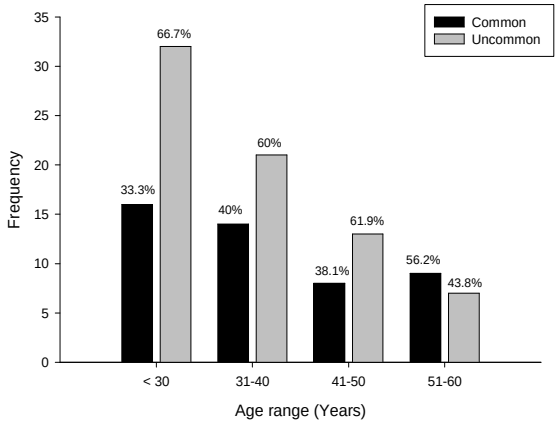

Fig. 2. The association between age and perception of prevalence of oculomycosis

There was no significant difference (P = .45) between eye care practitioners and their perceived perception of oculomycosis. (Pearson's Chi Square (χ^2) test)

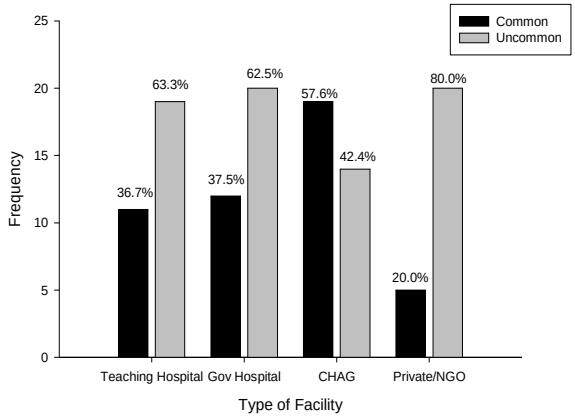

Fig. 3. The association between type of facilities and the perception of oculomycosis

There was a significant difference (P = .03) between the types of facilities that practitioners work and perceived prevalence of oculomycosis (Pearson's Chi Square (χ^2) test)

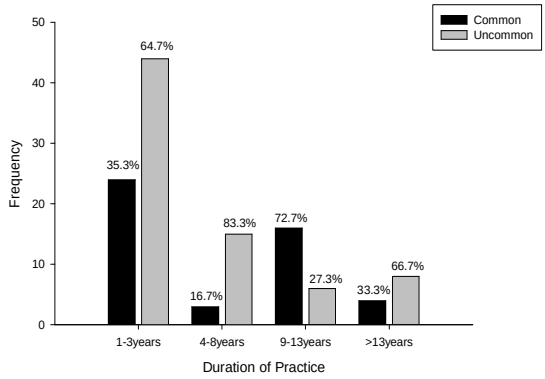

Fig. 4. The duration of practice of practitioners and the perception of prevalence on oculomycosis

There was a significant difference (P = .01) between the duration of practice of the eye care practitioners and their perception of prevalence of oculomycosis. (Pearson's Chi Square (χ^2) test)

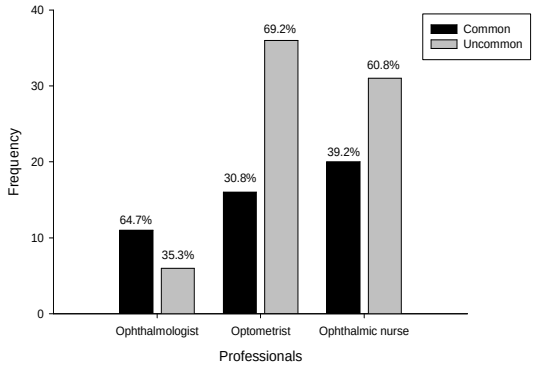

Fig. 5. The association between the professional and perception of prevalence of oculomycosis

There was a significant difference (P = .05) between eye care practitioners and their perceived perception of oculomycosis. (Pearson's Chi Square (χ^2) test)

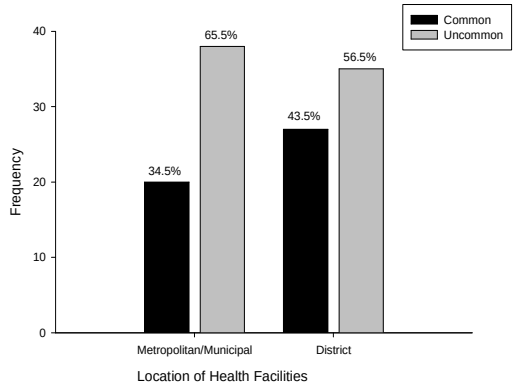

Fig. 6. The association between location of facilities and the perception of prevalence of oculomycosis

There was no significant difference (P = .20) between the location of eye facilities of eye care practitioners and perception of prevalence of oculomycosis (Pearson's Chi Square (χ^2) test)

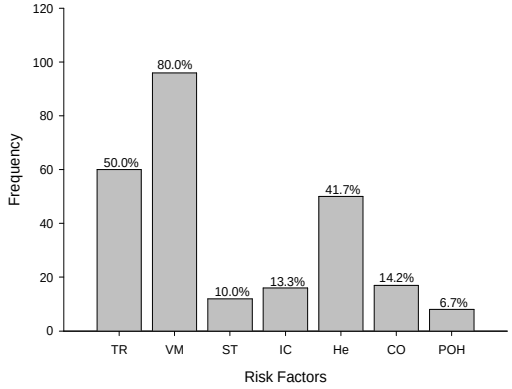

Fig. 7. Risk factors associated with oculomycosis as reported by practitioners

TR: *Trauma from other sources,* ***VM:*** *Trauma from vegetative matter,* ***ST:*** *Steroids use,* ***IC:*** *Immunocompromised Patient,* ***He:*** *Use of Herbals,* ***CO:*** *Chronic ocular surface disease,* ***POH:*** *Poor Ocular Hygiene*

The majority of the respondents were aged between twenty-one to forty years. Optometrists were the youngest of the three professionals in this study, possibly due to the direct entry into the 6-year Doctor of Optometry programme after graduating from the Senior High School. Even though the Ophthalmic Nurse training may be shorter, lasting between 6 months to one year in Ghana, entry into this programme requires a minimum of 5 years working experience as a General Nurse. Ophthalmic nurses are trained to assist ophthalmologists but because of the limited number of eye specialists in Ghana, they are directly involved in ophthalmic patient consultation under the supervision of ophthalmologists.

It was observed that the type of profession showed borderline association with the perception that oculomycosis was common. Probably, this was partly influenced by the disparities in the duration of practice of the various eye care professionals. The ophthalmologists were the oldest and had had longer duration of practice compared to the other professionals. Training to become an ophthalmologists requires between 3 to 5 years of residency in Ghana. Their training is based more on "hands on work" at the clinic, so by the time they complete their training they would have seen/encountered more patients with this ocular disorder. This makes them more proficient in the diagnosis and management of ocular conditions including oculomycosis. Nonetheless, it is also important to indicate that the responsibilities of each of the professionals differ depending on the setting they find themselves. Unlike what exists in the developed countries where optometrists

are the first point of entry for eye care, for most eye care facilities in Ghana having both optometrists and ophthalmologist, the ophthalmologist does patient consultation and rather refer patients with refractive errors when appropriate to the optometrist. Hence, there is the tendency that an optometrist may never come into direct contact with oculomycosis in practice. However, there are few ophthalmologists in the country and most are located in the urban areas which are further away from the farming communities [18]. In order to prevent blindness from oculomycosis, there would be the need to equally equip other eye care personnel who are more accessible to the affected communities.

The facility type in which the eye care practitioners work influenced their perception of oculomycosis. Practitioners from CHAG facilities indicated that oculomycosis was a frequently reported eye condition. Accounting for this may be because oculomycosis is more prevalent among agricultural workers and in rural communities where farming is the main occupation [20]. In Ghana, individual's first point of accessing health care is within their districts, where most of the CHAG hospitals are located.

Concerning seasonal variations in the prevalence of oculomycosis, most of the practitioners reported that the condition was presented to their clinics within the period of April-November while some indicated otherwise. Ibrahim et al. [21], indicated that in the tropical, and developing countries, the distribution of oculomycosis depends on socio-economic conditions, environmental characteristics (especially humidity and climatic changes), and geographical variations such as latitudinal positioning. McSweeney et al. [22] reported that the climate in Ghana is tropical and there are two main seasons: the wet season i.e. from April to November during which planting and harvesting is done and the dry season from December to March. One wet season occurs from March to July (with a peak in May-June), and a shorter wet season occurs in September to November [23]. These seasonal variations in the prevalence of oculomycosis are not surprising because it is the period for planting and harvesting of agricultural produce. Other practitioners indicated the presentation of oculomycosis in clinics to be all year round. This could be attributed climatic changes in the last decade. Few practitioners reported seasonal distribution of oculomycosis in the dry season. Bharathi et al. [24] reported a characteristic season similar to Ghana's dry season (hot, humid and windy season) where oculomycosis was higher and associated with agricultural activities. Ghana, however, has poor irrigation practice so the dry season is associated with less agricultural activities [25].

Assessing the risk factors of oculomycosis, eye care practitioners reported mainly trauma from vegetative matter (80%), trauma from other non-vegetative matter (50%) as common risk factor. This is in synchrony with other studies which also found trauma as a common risk factor for oculomycosis [20,26-28]. Oculomycosis could occur following an abrasion to the cornea, by a fungus-contaminated material (leaves, grain, branches, wood or soil) and occasionally from non-vegetative source. The introduced fungus causes granular infiltration of the corneal epithelium and the stroma which becomes apparent within 24 to 36 hours after the trauma [20]. The trauma to the cornea may be so slight as to be neglected by the individual. Farm workers and rural dwellers could be more at risk in this manner than individuals in "white collar jobs" living in cities or urban areas.

Other practices such as inappropriate use of herbs and traditional medicine preparations on the eye (41.7%), and the use of corticosteroids (10%) contribute to the incidence of oculomycosis. This may predispose persons to immunosuppression and eventually oculomycosis can occur. In developing countries, drugs are available over-the-counter to individuals, hence topical corticosteroids could be accessed easily [7]. The continued use of topical corticosteroids alter the local immune response and increased fungi virulence which promotes fungal replication and corneal invasion [28] resulting in oculomycosis. Also, immunocompromised state was reported by the practitioners as a risk factor for oculomycosis. Being immunocompromised suggests the impairment of the immune response in combating diseases. Fungi are capable of penetrating the deeper layers of ocular surface, especially the cornea [29]. This results in inflammation and further damage, such as scarring and cornea opacities, to the cornea [7].

This study has implications on diagnosis and management of oculomycosis in order to prevent blindness as could be realized that this sight-threatening disorder is common in Ghana, due to the reason that more than 40% of the general population are farmers and therefore at high risk of oculomycosis [30].

5. CONCLUSION

Oculomycosis is a prevalent ocular condition encountered by eye care practitioners, and its commonly associated risk factors are trauma from vegetative and non-vegetative matter, use of herbal preparations on the eye and other ocular surface diseases. The perception of oculomycosis was strongly associated with the practitioner's gender, duration of practice and facility type. Intensification of health education on its risk factors could help minimize or prevent this ocular condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Thomas PA. Current perspectives on ophthalmic mycoses. Clin Microbiol Rev. 2003;16(4):730–97.
   DOI: 10.1128/CMR.16.4.730-797.2003
2. Durand ML. Endophthalmitis: Clinical microbial infec. 2013;19(3):227-34.
3. Kanski JJ. Clinical Ophthalmology, 3rd edn. Betterworth Heinemann: London; 1994.
4. Srinivasan R, Kanungo R, Goyal JL. Spectrum of oculomycosis in South India. Acta Ophthalmol. 1991;69:744-9.
   PMID:1789089.
5. Shah A, Sachdev A, Coggon D, Hossain P. Geographic variations in microbial keratitis: An analysis of the peer-reviewed literature. Br J Ophthalmol. 2011;95:762–7.
   DOI: 10.1136/bjo.2009.169607
6. Bharathi MJ, Ramakrishnan R, Meenakshi R, Padmavathy S, Shivakumar C, Srinivasan M. Microbial keratitis in South India: influence of risk factors, climate, and geographical variation. Ophthalmic Epidemiol. 2007;14:61–9.
   PMID: 17464852
7. Sharma N, Agarwal PC, Sinha R, Titiyal JS, Vajpayee RB. Fungal keratitis. DOS Times. 2009;14(10):49-58.
8. Leck AK, Thomas PA, Hagan M, Kaliamurthy J, Ackuaku E, John M, et al. Aetiology of suppurative corneal ulcers in Ghana and south India, and epidemiology of fungal keratitis. Br J Ophthalmol. 2002;86:1211-5.
   PMID: 12386069
9. Upadhyay MP, Karmacharya PC, Koirala S, Tuladhar NR, Bryan LE, Smolin G, et al. Epidemiologic characteristics, predisposing factors, and etiologic diagnosis of corneal ulceration in Nepal. Am J Ophthalmol. 1991;111:92-9.
   PMID: 1985498
10. Dunlop AA, Wright ED, Howlader SA, Nazrul I, Husain R, McClellan K, Billson FA. Suppurative corneal ulceration in Bangladesh. A study of 142 cases examining the microbiological diagnosis, clinical and epidemiological features of bacterial and fungal keratitis. Aust N Z J Ophthalmol. 1994;22:105-10.
    PMID: 7917262
11. Al-Shakarchi F. Initial therapy for suppurative microbial keratitis in Iraq. Br J Ophthalmol. 2007;91:1583–7.
    DOI: 10.1136/bjo.2007.123208
12. Rose RH, Miller D, Alfonso FC. The changing spectrum of fungal keratitis in South Florida. Ophthalmology. 1994;101: 1005–13.
    PMID: 8008340
13. Maung N, Thant CC, Srinivasan M, Upadhyay MP, Priyadarsini B, MahalakshmiR, et al. Corneal ulceration in South East Asia. II. A strategy for the prevention of fungal keratitis at the village level in Burma. Br J Ophthalmol. 2006;90:968–70.
    PMID: 16707522
14. Laspina F, Samudio M, Cibils D, Ta CN, Farina N, Sanabria R, et al. Epidemiological characteristics of microbiological results on patients with infectious corneal ulcers: A 13-year survey in Paraguay. Graefes Arch Clin Exp Ophthalmol. 2004;242:204–9.
    PMID: 14760489
15. Sirikul T, Prabriputaloong T, Smathivat A, Chuck RS, Vongthongsri A. Pre-disposing factors and etiologic diagnosis of ulcerative keratitis. Cornea. 2008;27:283–7.
    DOI: 10.1097/ICO.0b013e31815ca0bb
16. Yilmaz S, Ozturk I, Maden A. Microbial keratitis in West Anatolia, Turkey: A retrospective review. Int Ophthalmol. 2007;27:261–8.
    PMID: 17453152
17. Sommer A. Epidemiology and statistics for the ophthalmologist. New York: Oxford University Press; 1980.
18. National Eye Care Unit. Eye Care Unit Annual Report 2011. Ghana Health Service: Accra, Ghana; 2011.

19. Besse SK. Restructuring patriachy: The modernization of gender inequality in Brazil, 1914-1940. Chapel Hill, North Carolina: The University of North Carolina Press; 1996.
20. Ansari Z, Miller D, Galor A. Current thoughts in fungal keratitis: Diagnosis and treatment. Curr Fungal Infect Rep. 2013;7(3):209–18.
DOI: 10.1007/s12281-013-0150-110.1007/s12281-013-0150-1
21. Ibrahim MM, de Angelis R, Lima AS, Viana de Carvalho GD, Ibrahim FM, et al. A New method to predict the epidemiology of fungal keratitis by monitoring the sales distribution of antifungal eye drops in Brazil. PLoS ONE. 2012;7(3):e33775.
DOI: 10.1371/journal.pone.0033775
22. McSweeney C, New M, Lizcano G. UNDP climate change country profiles-Ghana; 2008.
Available:http://ncsp.undp.org/document/undp-climate-change-country-profile-11
(Accessed January 29, 2016)
23. Stanturf JA, Warren ML, Charnley S, Polasky SC, Goodrick SL, Armah F, et al. Ghana climate change vulnerability and adaptation assessment. Report prepared by the USDA Forest Service, International Programs for review by the United States Agency for International Development (USAID); 2011.
24. Bharathi MJ, Ramakrishnan R, Vasu S, Meenakshi R, Palaniappan R. Epidemiological characteristics and laboratory diagnosis of fungal keratitis. A three-year study. Indian J Ophthalmol. 2003;51(4):315-21.
PMID: 14750619
25. Ministry of Food and Agriculture. Agriculture in Ghana: Facts and Figures (2012). Statistics, Research and Information Directorate (SRID). 2013;1-64.
26. Klotz SA, Penn CC, Negvesky GJ, Butrus SI. Fungal and parasitic infections of the eye. Clin Microbiol Rev. 2000;13:662–85.
PMCID: PMC88956
27. El-Seidi EA, Ibrahim ZA, El-Hodaky SK, and Hasan HA. Characterization of ocular fungal infections in Egypt. Egypt J Med Microbiol. 2006;15(1):237-48.
28. Nayak N. Fungal infections of the eye--Laboratory diagnosis and treatment. Nepal Med Coll J. 2008;10(1):48-63.
PMID: 18700633
29. Mravičić I, Dekaris I, Gabrić N, Romac I, Glavota V, Mlinarić-Missoni E. An overview of fungal keratitis and case report on trichophyton keratitis. In: Srinivasan M, Editor. China: In TechOpen; 2012.
30. Ghana Statistical Service. 2010 Population and Housing Census. Summary report of final results. Ghana Stat Serv; 2012.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/14122