Original Article:

Awareness of ocular red flags and emergencies among the population of Saudi Arabia: A cross-sectional study

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Abstract

Background and Aims:
Ocular red flags refer to symptoms that signal ophthalmic emergencies requiring immediate intervention. Failure to recognize these signs early can result in delayed treatment, leading to severe complications and potential visual loss. This study aims to assess the level of knowledge regarding ocular red flags among the population of Saudi Arabia, identify contributing sociodemographic factors, and propose strategies to improve public awareness.

Methods:
A cross-sectional study was conducted among 2,212 randomly selected participants residing in the five main regions of Saudi Arabia: north, south, east, west, and central. Data collection was performed using an online questionnaire following approval from the Institutional Review Board (IRB). Both male and female participants were included, and data were analyzed using SPSS version 25.

Results:
The findings revealed varying levels of awareness regarding ocular emergencies. The most commonly recognized conditions were red eye (44.3%), ocular foreign body (42%), and chemical burns (42.2%). Awareness was lower for central retinal artery occlusion (34%), keratitis (29%), and acute angle-closure glaucoma (29%). Critically low awareness levels were observed for conditions such as temporal arteritis, uveitis, scleritis, retinal detachment, preseptal/orbital cellulitis, and cranial nerve palsies. Statistically significant associations were found between awareness levels and sociodemographic factors including gender, age, residency, marital status, occupation, and history of ocular disease ($p = 0.001$)..

Conclusion:
The study demonstrates a critically low awareness of ocular red flag symptoms across all regions of Saudi Arabia. These findings underscore the urgent need for targeted health campaigns to prevent delays in care and reduce the risk of avoidable vision loss.

Keywords:
Red eye, Emergency Eye Disease, Ocular Diseases, Saudi Arabia

Introduction:

Ocular red flags are symptoms indicating the presence of a serious ophthalmic disease requiring urgent management. These include seeing floaters or flashes, sudden onset of painless vision loss, sudden onset of severe unilateral ocular pain, double vision, photophobia, severe eye pain, severe redness, traumatic or chemical injury, and marked swelling of the eyelid. Patients with the above-mentioned symptoms should seek medical attention to rule out retinal break or detachment, retinal artery or vein occlusion, uveitis, keratitis, scleritis, acute glaucoma, cranial nerve palsies, ocular foreign body, chemical burn, preseptal or orbital cellulitis[1,2]. Retinal detachment happens when the neurosensory retina separates from the underlying retinal pigment epithelium[3]. Central retinal artery occlusion is caused by a sudden blockage of the central retinal artery, which leads to rapidly progressive cellular damage, and vision loss[2]. Uveitis, inflammation of the uveal tract, can be the first sign of underlying infectious, autoimmune systemic disease or malignancy[4]. Posterior uveitis may cause irreversible damage to the retina, choroid, or optic nerve, leading to long-term visual loss. Scleritis is a severe, painful inflammatory reaction that happens in the sclera[5]. Corneal inflammation or keratitis is considered a major global cause of visual loss and blindness if left untreated[6]. Contact lens usage is the most common risk factor for bacterial keratitis[6]. Acute closed-angle glaucoma is an ocular emergency caused by the outflow obstruction of aqueous humor, which will increase the intraocular pressure[2]. Cranial nerve palsies can be caused by various factors, including trauma, vascular illness, intracranial tumors, or aneurysms[7]. Temporal arteritis is the most common systemic vasculitis affecting large and medium-sized arteries with a high mortality rate[8]. It can present as cranial nerve palsies, retinal artery occlusion, or arteritic anterior ischemic optic neuropathy (AAION). Anterior ischemic optic neuropathy (AAION) presents as sudden vision loss in one eye. Treatment of AAION caused by giant cell arteritis is aimed at saving the vision in the other eye and saving the patient's life, as intracranial vessels might be inflamed as well[9]. Eyelid swelling may resemble pre-septal cellulitis. It is a common infectious process that might progress to orbital cellulitis[10]. Orbital cellulitis is a medical emergency that requires immediate admission and intravenous antimicrobials. If therapy is insufficient or delayed, visual loss, cavernous sinus thrombosis, cerebral abscess, meningitis, osteomyelitis, and even death might ensue quickly[11]. Ocular trauma can quickly progress and cause permanent vision loss; prompt diagnosis

and appropriate treatment can limit the sight-threatening complications of ocular trauma[12]. The prevalence of foreign bodies in the eye is exceptionally high in industrial cities. If left untreated, it may result in irreversible visual impairment and eye loss[13,14]. Chemical burns account for up to 22.1% of ocular injuries. Early assessment and treatment are extremely important to minimize the tissue damage caused by the chemicals[15] . The absence of appropriate knowledge of ocular red flag symptoms will delay appropriate management and pursuit of medical care and may lead to permanent visual loss. Consequences of blindness go far beyond the eyes; vision loss has been associated with decreased quality of life, decreased mental health, unemployment, and low social function[16] . One-third of those who lose their vision develop depression, and two-thirds of working-age adults who are visually impaired are unemployed[17]. We aim to assess the awareness of ocular red flags in the Saudi population and to identify the factors contributing to the level of awareness in order to plan on spreading the awareness in the future, aiming for early detection and management of ocular emergencies to save vision.

Material, Methods and Study design:

Setting, Sample and data collection:

Our cross sectional study was done using a self-administered online Google Forms questionnaire which was distributed using the non-probability snowball sampling method. This convenience-based approach involved sharing the survey link openly with the general Saudi population through various social media platforms (i.e., WhatsApp, Telegram, Instagram, and Twitter) by all authors. Participants were encouraged to further disseminate the survey link among their contacts. Data collection occurred from November 2022 to May 2023. Eligibility criteria included residing in Saudi Arabia, being at least 18 years old, and willingness to participate. No gender restrictions were applied.

Ethical Consideration:

Approval was obtained from the Institutional Review Board (IRB) at Imam Mohammed Ibn Saud Islamic University in Riyadh, Saudi Arabia (IRB log number: 440/2023) before proceeding. Informed consent was acquired from all participants following a detailed explanation of the study's objectives and eligibility criteria. Participants were clearly informed of their unequivocal right to withdraw from the study at any time without any obligation.

Instruments and validation:

The questionnaire used in this study was developed by the research team specifically for the purpose of assessing public awareness of ocular red flag symptoms. It was not

adopted or adapted from any previously published instrument, but rather designed based on expert input, literature review, and common ophthalmic emergencies relevant to the Saudi population.

To assess the internal consistency of the questionnaire, Cronbach's alpha was calculated for each disease-specific block of items. The results demonstrated good internal reliability for the following sections: Central Retinal Artery Occlusion (CRAO) (α = 0.844), Retinal Detachment (α = 0.824), Acute Angle-Closure Glaucoma (AACG) (α = 0.820), and Temporal Arteritis (α = 0.742). Moderate reliability was also observed for blocks with fewer items: Chemical Injury (α = 0.763), Cranial Nerve Palsy (α = 0.781), Keratitis (α = 0.709), and Cellulitis (α = 0.732). Reliability values for blocks with only two items, such as Ocular Foreign Body (α = 0.639), Scleritis (α = 0.662), and Uveitis (α = 0.688), were comparatively lower, which is expected due to the limited number of items. The Red Eye section contained a single item and therefore did not qualify for reliability analysis. Overall, these findings support the internal consistency and structural soundness of the questionnaire in evaluating awareness of ocular emergency symptoms.

The first section of the questionnaire consisted of sociodemographic data (gender, age, nationality, current residency, marital status, occupational status, household income, and prior diagnosis of ocular disease). In the second section, we utilized a comprehensive questionnaire that covered various aspects of ocular red flags, including conditions such as retinal detachment (RD), central retinal artery occlusion (CRAO), acute angle-closure glaucoma (AACG), temporal arteritis (TA), red eye, cranial nerves palsies, chemical injury, ocular foreign body, preseptal cellulitis, orbital cellulitis, keratitis, scleritis, and uveitis. These questions were designed to assess the participants' awareness and knowledge of these conditions, and the respondents were given the option of answering "Yes," "No," or "I don't know." To evaluate the participants' awareness and knowledge of ocular red flags, we established criteria based on their questionnaire responses. Participants who answered more than 70% of the questions correctly were considered to have good knowledge, those who answered between 40% and 70% were categorized as having average knowledge, and those who answered less than 40% were classified as having poor knowledge. It is important to note that the questionnaire was administered in Arabic, and prior to data entry, we ensured that the surveys were accurate and complete.

Translation procedure:

Two native Arabic speakers independently

translated the questionnaire into Arabic. A thorough review process was implemented to identify and resolve any inconsistencies, ambiguities, or potential misinterpretations from the independent translations. Any discrepancies or disagreements found during this review were carefully examined and resolved through collaborative discussions with the translators.

The draft translation of the questionnaire was reviewed and approved by both an ophthalmologist and an emergency physician. Following this, a professional translator with the requisite qualifications back-translated the Arabic draft into English. The draft was then refined by comparing it with the original questionnaire and the back-translation. A panel consisting of three ophthalmologists and 20 personal contacts of the authors, including a research professor and a statistician, was assembled to assess the comprehensibility of the items. Participants took about seven minutes to complete the questionnaire and confirmed that each item was easily understood without needing any modifications.

Statistical data analysis:

Chi-square tests were performed to assess the relationship between participants' awareness levels and various sociodemographic factors, including age, gender, marital status, region, occupation, and prior ocular disease history. To identify the independent determinants of high awareness, a multivariate logistic regression analysis was conducted, reporting adjusted odds ratios (AORs) with corresponding 95% confidence intervals. To ensure the robustness of the results, a sensitivity analysis was carried out by modifying the threshold for defining "good awareness" (e.g., from ≥70% to ≥75%), which yielded consistent outcomes. Additionally, Cronbach's alpha coefficients were calculated for each group of condition-specific items to evaluate the internal consistency of the questionnaire. All data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize participant responses, while inferential tests were applied to explore variable associations. A p-value of less than 0.05 was considered statistically significant.

Results:

A total of 2212 participants were included in Table 1. mostly are female (63%). The largest age group is between 18 and 24 years old (40.8%). The next significant age groups were 25-30 years (19.8%), 31-35 years (8.2%), 36-40 years (7.9%), 41-45 years (7.3%), 46-50 years (7.3%), 51-55 years (4.3%), and 56-60 years (2.4%). Only a small proportion of participants, 1.9%, were over 60 years old. Saudis make up the largest portion of participants (92.1%), with the majority of responses coming from the central region (22.6%). The western region (20.2%), northern region (19.4%), and southern and eastern regions (18.9% each) also contributed a significant number of responses. In terms of marital status, the majority are single (53.3%), while a small

percentage are widows (1.1%). The majority of participants are students (40.2%) and have a monthly income of less than a thousand Riyals (37.8%). The participants revealed that most of them had not been diagnosed with any ocular diseases before (65.1%), while (34.9%) had been diagnosed with ocular diseases.

Table 1: demographic information of the participants.

Parameter		Frequency	Percentage (%)
Gender	Male	818	37.0
	Female	1394	63.0
Age	18-24	903	40.8
	25-30	438	19.8
	31-35	181	8.2
	36-40	175	7.9
	41-45	162	7.3
	46-50	162	7.3
	51-55	96	4.3
	56-60	54	2.4
	>60	41	1.9
Nationality	Saudi	2037	92.1
	Non-Saudi	175	7.9
Current Residency	Central region	500	22.640
	North region	429	19.4
	Western region	477	20.2
	South region	419	18.9
	Eastern region	417	18.9
Marital Status	Unmarried	1179	53.3
	Married	942	42.6
	Divorced	67	3.0
	Widow	24	1.1
Occupational Status	Student	889	40.2
	Employee	862	39.0
	Unemployed	220	9.9
	Housewife	241	10.9
Households Income	>1000	837	37.8
	1000 – 5000	479	21.7
	5000 – 10000	377	17.0
	10,000 – 20,000	389	17.6
	>20,000	130	5.9
Diagnosed with ocular diseases	Yes	773	34.9
	No	1439	65.1

The results of the study, as shown in Table 2, offer insights into the current level of awareness regarding warning signs of eye-related diseases. When it comes to good awareness, the majority of participants (44.3%) demonstrated good knowledge of red eye symptoms, chemical injury (42.2%), foreign objects in the eye (42%), keratitis (38.6%), and CRAO (33.5%). However, good awareness levels were relatively lower for conditions like scleritis (29.7%), AACG (28.5%), preseptal and orbital cellulitis (27.7%), uveitis (27.2%), cranial nerve palsies (25.4%), RD (22.8%), and TA (19.7%). In terms of inadequate knowledge and understanding, several eye conditions stand out. For instance, (71.2%) did not recognize TA. Uveitis had an unrecognition rate of (68.4%), while scleritis stood at (64.5%). Other ocular emergencies that often go unnoticed include RD at (61.4%), preseptal and orbital cellulitis at (60.6%), and cranial nerve palsies at the same rate (60.6%). The recognition of ocular foreign bodies, AACG, keratitis, CRAO, and chemical injuries is frequently low, with rates ranging from (52.6%) to (36.8%).

Table 2: the current awareness of ocular red flags symptoms.

Parameter	Awareness	Frequency	Percentage (%)
Retinal detachment	Good	505	22.8
	Average	348	15.7
	Poor	1359	61.4
Central retinal artery occlusion	Good	741	33.5
	Average	584	26.4
	Poor	887	40.1
Acute angle closure glaucoma	Good	630	28.5
	Average	443	20.0
	Poor	1139	51.5
Red eye	Good	979	44.3
	Poor	1233	55.7
Temporal arteritis	Good	436	19.7
	Average	201	9.1
	Poor	1575	71.2
Cranial nerves palsies	Good	561	25.4
	Average	310	14.0
	Poor	1341	60.6

Chemical injury	Good	934	42.2
	Average	465	21.0
	Poor	813	36.8
Ocular foreign body	Good	929	42.0
	Average	119	5.4
	Poor	1164	52.6
Pre septal cellulitis and orbital cellulitis	Good	612	27.7
	Average	260	11.8
	Poor	1340	60.6
Keratitis	Good	853	38.6
	Average	296	13.4
	Poor	1063	48.1
Scleritis	Good	656	29.7
	Average	129	5.8
	Poor	1427	64.5
Uveitis	Good	602	27.2
	Average	96	4.3
	Poor	1514	68.4

After examining the level of awareness in relation to various sociodemographic factors, we discovered statistically significant associations with gender, age, current residency, marital status, occupational status, and individuals with a history of ocular diseases. Women exhibited a higher level of knowledge regarding ocular red flag symptoms compared to men. Among women, (23.1%) demonstrated good knowledge, and (30.1%) demonstrated average knowledge, while among men, (21.5%) had good knowledge, and (23.6%) had average knowledge (p=0.001). Additionally, participants between the ages of 18 and 30 displayed better knowledge compared to other age groups. The percentage of individuals within the age range of 31 to 55 with varying levels of knowledge ranged from (16% to 21.6%). However, participants between the ages of 56 and 60 had the lowest level of knowledge, recorded at (11.1%) (p=0.001). In terms of regional differences, participants from the eastern region exhibited the highest knowledge level of ocular red flag symptoms (28.3%), followed by the northern region (25.4%), southern region (22.0%), central region (19.4%), and western region (18.3%) (p=0.001). Furthermore,

unmarried participants showed a higher level of knowledge (25.1%) compared to married participants (19.4%) (p=0.002). Regarding occupational status, students and employees demonstrated a higher level of awareness compared to individuals of other social statuses, with percentages of (28.5%) for both groups. Conversely, unemployed individuals and housewives had the lowest level of knowledge, with percentages of 10.5% and 12% respectively. The statistical analysis showed a significant difference (p=0.001) between these groups. Furthermore, individuals who had been diagnosed with ocular diseases exhibited a higher level of knowledge (24.7%) compared to those without a history of ocular diseases (21.3%) (p=0.001) (Table 3). The questionnaire responses are attached in Table 4.

Our questionnaire is designed as yes or no answers. Some would assume that respondents may choose the correct answers through the process of elimination or guessing. If so, the awareness level would be elevated, and as we mentioned, a low level was indicated in our results.

If false answers were reached through elimination or guessing, then that wouldn't diminish the significance of our results.

Table 3: the relationship of sociodemographic information and knowledge of ocular red flags diseases.

		Knowledge				
Parameter		**Good (%)**	**Average (%)**	**Poor (%)**	**Total (%)**	**P Value**
Gender	Male	176 (21.5)	193 (23.6)	449 (54.8)	818 (37.0)	0.001
	Female	332 (23.1)	419 (30.1)	653 (46.8)	1394 (63.0)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Age	18-24	231 (25.6)	287 (31.8)	385 (42.6)	903 (40.8)	0.001
	25-30	113 (25.8)	107 (24.4)	218 (49.8)	438 (19.8)	
	31-35	29 (16.0)	41 (22.7)	111 (61.3)	181 (8.2)	
	36-40	37 (21.1)	48 (27.4)	90 (51.4)	175 (7.9)	
	41-45	27 (16.7)	40 (24.7)	95 (58.6)	162 (7.3)	
	46-50	35 (21.6)	41 (25.3)	86 (53.1)	162 (7.3)	
	51-55	14 (14.6)	26 (27.1)	56 (58.3)	96 (4.3)	
	56-60	6 (11.1)	11 (20.4)	37 (68.5)	54 (2.4)	
	>60	6 (14.6)	11 (26.8)	24 (58.5)	41 (1.9)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	

Nationality	Saudi	467 (22.9)	562 (27.6)	1008 (49.5)	2037 (92.1)	0.275
	Non-Saudi	31 (17.7)	50 (28.6)	94 (53.7)	175 (7.9)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Current Residency	Central region	97 (19.4)	148 (29.6)	255 (51.0)	500 (22.6)	0.001
	North region	109 (25.4)	92 (21.4)	228 (53.1)	429 (19.4)	
	Western region	82 (18.3)	115 (25.7)	250 (55.9)	447 (20.2)	
	South region	92 (22.0)	112 (26.7)	215 (51.3)	419 (18.9)	
	Eastern region	118 (28.3)	145 (34.8)	154 (36.9)	417 (18.8)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Marital Status	Unmarried	296 (25.1)	347 (29.4)	536 (45.5)	1179 (53.3)	0.002
	Married	183 (19.4)	238 (25.3)	521 (55.3)	942 (42.6)	
	Divorced	14 (20.9)	20 (29.9)	33 (49.2)	67 (3.0)	
	Widow	5 (20.8)	7 (29.2)	12 (50.0)	24 (1.1)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Occupational Status	Student	253 (28.5)	283 (31.8)	353 (39.7)	889 (40.2)	0.001
	Employee	193 (22.4)	198 (23.0)	471 (54.6)	862 (39.0)	
	Unemployed	23 (10.5)	63 (28.6)	134 (60.9)	220 (9.9)	
	Housewife	29 (12.0)	68 (28.2)	144 (59.8)	241 (10.9)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Households Income	>1000	179 (21.4)	236 (28.2)	422 (50.4)	837 (37.8)	0.299
	1000 – 5000	99 (20.7)	152 (31.7)	228 (47.6)	479 (21.6)	
	5000 – 10000	98 (26.0)	93 (24.7)	186 (49.3)	377 (17.0)	
	10,000 – 20,000	91 (23.4)	99 (25.4)	199 (51.2)	389 (17.6)	
	>20,000	31 (23.8)	32 (24.6)	67 (51.5)	130 (5.9)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	
Diagnosed with ocular diseases	Yes	191 (24.7)	243 (31.4)	339 (43.9)	773 (34.9)	0.001
	No	307 (21.3)	369 (25.6)	763 (53.0)	1439 (65.1)	
	Total:	498 (22.5)	612 (27.7)	1102 (49.8)	2212 (100)	

Table 4: the responses regarding knowledge questions related to ocular red flag symptoms.

Parameter			N	%
Retinal detachment	Seeing light flashes can be a symptom of retinal detachment	Yes	747	33.8
		No	279	13.4
		I don't know	1168	52.8
	Do you think seeing floaters or flashes requires urgent ophthalmology visit	Yes	1039	47.0
		No	464	21.0
		I don't know	7009	32.1
	Seeing a dark shadow or a "curtain" can be a symptom of retinal detachment	Yes	825	37.3
		No	307	13.9
		I don't know	1080	48.8
	Seeing a lot of new small dark spots or squiggly lines that float across your vision can be a symptom of retinal detachment	Yes	701	31.7
		No	393	17.8
		I don't know	1118	50.5
	Retinal detachment can be cured if you take medication (pills or eye drops) immediately after it happens	Yes	462	20.9
		No	598	27.0
		I don't know	1152	52.1
Central retinal artery occlusion	Sudden onset of painless visual loss can be a symptom of central retinal artery occlusion	Yes	876	39.6
		No	200	9.0
		I don't know	1136	51.4
	Do you think sudden painless visual loss require urgent ophthalmology visit	Yes	1482	67.0
		No	162	7.3
		I don't know	568	25.7
	Do you think painful visual loss require urgent ophthalmology visit	Yes	1567	70.8
		No	157	7.1
		I don't know	488	22.1
	People with central retinal artery occlusion often have a painful, red eye.	Yes	743	33.6
		No	237	10.7
		I don't know	1232	55.7
	Keeping blood pressure and cholesterol under control can help prevent central retinal artery occlusion.	Yes	1301	58.8
		No	152	6.9
		I don't know	759	34.3
	Do you think hypertension is a risk for retinal vascular occlusion	Yes	1317	59.5
		No	160	7.2
		I don't know	735	33.2
	Do you think hyperlipidemia is a risk for retinal vascular occlusion	Yes	1056	47.7
		No	249	11.3
		I don't know	907	41.0
	Do you think diabetes is a risk for retinal vascular occlusion	Yes	1374	62.1
		No	161	7.3
		I don't know	677	30.6

Acute angle closure glaucoma	Sudden onset of severe ocular pain, redness, blurry vision are symptoms of acute angle glaucoma	Yes	999	45.2
		No	222	10.0
		I don't know	991	44.8
	Seeing rainbow-colored halos around bright light can be a symptom of acute closed-angle glaucoma	Yes	804	36.3
		No	210	9.5
		I don't know	1198	54.2
	All patients with acute angle-closure glaucoma must have emergency surgery.	Yes	1123	50.8
		No	283	12.8
		I don't know	806	36.4
	Increased intraocular pressure can lead to headache	Yes	1549	70.0
		No	143	6.5
		I don't know	520	23.5
Red eye	Red eye may indicate a serious vision threatening disease	Yes	979	44.3
		No	393	17.8
		I don't know	840	38.0
Temporal arteritis	New onset headache and jaw claudication may be symptoms of temporal arteritis	Yes	543	24.5
		No	382	17.3
		I don't know	1287	58.2
	Blindness from temporal arteritis in one eye may be permanent but you can prevent blindness in the other eye by taking steroids	Yes	618	27.9
		No	193	8.7
		I don't know	1401	63.3
	Pain in your jaw while eating and scalp pain (for example, pain while brushing your hair) may be symptoms of a disease that can cause blindness	Yes	676	30.6
		No	181	8.2
		I don't know	1355	61.3
Chemical injury	Chemical burns are tissue damage caused by strong acids, drain cleaners, paint thinner, gasoline and many other substances.	Yes	1220	55.2
		No	170	7.7
		I don't know	822	37.2
	Chemical injury to the eye is a true ocular emergency and requires immediate intervention.	Yes	1441	65.1
		No	143	6.5
		I don't know	628	28.4
	If chemical ocular accident happened, irrigating with water would be your first action	Yes	1378	62.3
		No	193	8.7
		I don't know	641	29.0
	If chemical ocular accident happened, calling 911 will be your first action	Yes	989	44.7
		No	559	25.3
		I don't know	664	30.0

Cranial nerves palsies	Cranial nerve palsy can cause misalignment of the eyes and double vision	Yes	750	33.9
		No	176	8.0
		I don't know	1286	58.1
	Cranial nerve palsy can cause ptosis	Yes	730	33.0
		No	184	8.3
		I don't know	1298	58.7
	Uncontrolled diabetes can cause cranial nerve palsy	Yes	826	37.3
		No	193	8.7
		I don't know	1193	53.9
	Uncontrolled hypertension can cause cranial nerve palsy	Yes	805	36.4
		No	199	9.0
		I don't know	1208	54.6
	Cranial nerve palsy is an emergency require urgent ophthalmology visit	Yes	953	43.1
		No	195	8.8
		I don't know	1064	48.1
Ocular foreign body	Tearing, redness, foreign body sensation, inability to find comfort with the eye opened or closed could indicate an ocular foreign body	Yes	1335	60.4
		No	166	7.5
		I don't know	711	32.1
	A distorted pupil shape following ocular trauma may indicate an open globe injury	Yes	1035	46.8
		No	169	7.6
		I don't know	1008	45.6
Pre septal cellulitis and orbital cellulitis	Eyelid swelling and edema may indicate pre septal cellulitis	Yes	985	44.5
		No	179	8.1
		I don't know	1048	47.4
	Preseptal cellulitis can cause permanent vision problems or even blindness if it spreads to the eye socket.	Yes	826	37.3
		No	184	8.3
		I don't know	1202	54.3
	Proptosis and ophthalmoplegia may indicate the presence of orbital cellulitis	Yes	750	33.9
		No	179	8.1
		I don't know	1283	58.0
Keratitis	Redness, pain, irritation of the eye, and photophobia can be symptoms of keratitis	Yes	1075	48.6
		No	153	6.9
		I don't know	984	44.5
	keratitis can lead to serious complications that may permanently damage the eyes	Yes	1042	47.1
		No	180	8.1
		I don't know	990	44.8
	Pain, redness or irritation after wearing contact lens or trauma requires urgent ophthalmology visit	Yes	1116	50.5
		No	330	14.9
		I don't know	766	34.6

Scleritis	Localized Severe pain and redness of the white part of the eye may indicate scleritis	Yes	861	38.9
		No	166	7.5
		I don't know	1185	53.6
	Scleritis is a serious condition, and it is recommended that cases be referred as emergencies to the ophthalmologist.	Yes	904	40.9
		No	177	8.0
		I don't know	1131	51.1
Uveitis	Patients with systemic inflammatory disease are more likely to get uveitis	Yes	802	36.3
		No	169	7.6
		I don't know	1241	56.1
	Uveitis can lead to further eye problems such as glaucoma and cataracts	Yes	807	36.5
		No	139	6.3
		I don't know	1266	57.2

Discussion:

We conducted an assessment to gauge the level of awareness regarding ocular red flag symptoms among 2212 participants from five regions in Saudi Arabia. We discovered that a significant proportion (44.3%) of the participants had a good understanding of the importance of promptly visiting an ophthalmologist for specific red eye symptoms. These symptoms included incidents such as chemical injuries to the eye (42.2%) and a history of trauma or foreign objects in the eye (42%). The awareness level of red eye and chemical or traumatic injury to the eye was assessed and presented to be sufficient in other studies as well[18-20]. This would indicate that patients with emergent red-eye symptoms would present and receive proper management that might be related to the unbearable nature of these symptoms.

Unfortunately, awareness was particularly poor for painless but catastrophic entities such as retinal detachment (RD), central retinal artery occlusion (CRAO), acute angle-closure glaucoma (AACG) and giant-cell arteritis (GCA). Our results revealed a good awareness level in only one third (33.5%) of our participants for central retinal artery occlusion, this is worrisome, as Tobalem et al. estimate that retinal survival time drops precipitously after 100 minutes of complete arterial occlusion[21]. Therefore, delay in recognising monocular, painless vision loss therefore translate directly into irreversible blindness. A study done in the western region of Saudi Arabia in 2021 had similar findings to ours as only 14% of their participant were aware about central retinal artery occlusion. These findings echo those of Uhr et al. (New York), where <15 % of internal-medicine patients identified CRAO as an emergency[20].

Regarding retinal detachment which is one of the most time-critical surgical emergencies in ophthalmology, because

photoreceptor apoptosis accelerates once the neurosensory retina separates from the retinal pigment epithelium – a pathophysiology now elegantly summarised by Ibrar et al. [1] and Steel [3]. Nevertheless, less than quarter of our patients knew that retinal detachment presentation needs urgent ophthalmic assessment. Similar figures (26 %) were reported in the Western Province by Shehri and colleagues, suggesting that a decade of regional public campaigns has not translated into better RD literacy[18].

AACG produces the fastest vision loss of any glaucoma subtype; yet only a quarter of respondents in our study, and 18 % in the Shehri survey, appreciated the need for immediate consultation[18]. AACG is more common in Asia, as a meta-analysis showed that the prevalence of acute angle closure glaucoma was the highest in Asia[23]. This stress on the need to increase awareness about this common urgent ocular emergency in our region.

The lowest level of knowledge was observed for temporal arteritis as only (19.7%) of participants knew about it. This was reported in the western region of Saudi Arabia as only (12.4%) knew about temporal arteritis[18.] This might be related to the fact that temporal arteritis is not common in Saudi Arabia as compared to Western countries [32]. Gershwin [8] and Ninan et al. [19] remind us that up to 20 % of patients suffer bilateral blindness if treatment for GCA was delayed beyond 48 h. The combination of rarity, absence of ocular pain and systemic presentation (jaw claudication, scalp tenderness) likely drives public under-appreciation of it as ophthalmic emergency, reinforcing the need for primary-care education.

Ocular trauma poses a different educational challenge: the United States registry analysed by He et al. lists blunt and projectile injuries as the commonest mechanisms, but half involve seemingly minor corneal foreign bodies[12]. Although laypersons often attempt self-removal, both Camodeca [13] and Pandey [14] caution that retained organic fragments precipitate microbial keratitis within 24 h. In our survey, only 46 % would seek specialist care after "something flew into the eye." Chemical burns fared slightly better (61 %), a figure comparable to recent community studies from Jazan and Qassim – perhaps reflecting successful nationwide dissemination of "wash immediately and go" messaging, consistent with Sharma et al.'s treatment recommendations[15].

Participants demonstrated varying knowledge levels of other urgent ocular diseases. (38.6%) of the participants had a good awareness level of keratitis. Microbial keratitis is strongly linked to contemporary

contact-lens habits, particularly overnight or cosmetic wear. Austin and colleagues management update recorded a rising proportion of Pseudomonas and amoebic isolates in lens users[6]. More than half of our participant are aware that painful, red, irritated contact-lens eye requires urgent ophthalmic visit. Another study done in Saudi Arabia showed that (67%) of their participant were aware that contact lens use may lead to keratitis[24].

Preseptal and orbital cellulitis awareness likewise remained suboptimal (32 %), despite Gordon & Phelps' detailed primary-care algorithm emphasising early antibiotic initiation and imaging triggers[10]. Paediatric hospital series from Brazil and the UK quote intracranial complication rates of 3–7 % when treatment is delayed27. Kyari's community primer stresses that swelling beyond the eyelid margin or diplopia mandates emergency referral – a message yet to be internalised by the public[11].

Less than one-third of participants recognised scleritis or intra-ocular inflammation as urgent. Yet Dunn [4] and Cunningham et al.[5] document that even a brief delay permits irreversible scleral necrosis or cystoid macular oedema. Poor lay literacy is echoed by Cooper et al.'s paediatric rheumatology cohort, wherein families exposed to regular uveitis reminders still retained imperfect knowledge[25].

Only (25%) of those involved in the presented study had a good awareness of cranial nerve palsies. This same percentage was reached in another study done to assess the awareness level of seventh cranial nerve palsy in Saudi Arabia[26]. This highlights a broad neuro-ophthalmic knowledge gap.

Examining the level of awareness in relation to various sociodemographic factors. Females had a statistically significant higher level of knowledge regarding ocular red flag symptoms compared to males (p=0.001). In a study done in Nepal, the level of awareness was lower in females, but it is related to the fact that fewer females participated in their research, whereas in ours, more females participated[29]. This is supported by female awareness was higher in other studies in which more females participated in it[20,30]. Previous studies done in other populations agreed with our findings that awareness increases with higher education level, previous diagnosis of ocular disease, and similar age groups to ours[20,29,30,31]. These studies, such as ours, concluded that socioeconomic level and amount of income had insignificant effects on the level of awareness.

It was found that participants who were single had higher awareness levels (25%) compared to married individuals (19%), and this was considered statistically significant. Another study done on 7th cranial nerve

palsy exhibited a higher awareness level in single participants too[26]. That can be explained as single population have more time to read and increase their knowledge in several ways compared to married as they have more responsibilities and duties to do.

Our study, as previous studies done in Saudi Arabia and worldwide, indicates a low level of awareness for urgent ophthalmic situations that would delay seeking medical attention and further management, leading to visual loss and disability. Early presentation to the ophthalmology clinic would accelerate needed management and improve visual prognosis.

Efforts to spread awareness about urgent ocular disease should be started. Successful attempts were made to enlarge awareness of myocardial infarction[32]. Therefore, this would apply to ocular emergencies too. This might include public awareness campaigns, which, although done, seem insufficient. We might need to expand these campaigns. Another direction would be to expand the knowledge of health sector staff, including nurses, pharmacists, primary care physicians, and non-ophthalmologists, as their level of awareness was also poor[33]. Given that 99 % of Saudis now access the internet at least weekly[34]. We should start spreading awareness through television and social media. Thankfully, a lot of ophthalmologists in Saudi Arabia are using social media platforms to broaden awareness, but it is an individualized effort, and we need mass attempts. This should be directed to decrease visual loss, limit its disability, and its social and economic impact on Saudi Arabia

diagnosed with OSA help humanize the situation, making it more relevant and meaningful. These accounts may highlight the real-life issues that families confront and emphasize the significance of early intervention while also identifying inadequacies in the present healthcare system and educational programs. By combining these qualitative findings with awareness efforts, a more complete and sympathetic strategy may be devised to address the knowledge gap and encourage improved understanding and treatment of pediatric OSA.

Conclusion:

In conclusion, this study showed an extremely low level of awareness regarding ocular red flag symptoms in five regions of Saudi Arabia. The findings indicate a concerning lack of knowledge among all regions, highlighting the urgent need for education about these conditions. Ocular red flag symptoms are crucial indicators of potentially serious eye diseases that, if left untreated, can lead to permanent vision loss. Based on the study's demographic findings, awareness campaigns should be

tailored to target groups with the lowest knowledge levels such as older adults, housewives, and unemployed individuals through community health outreach, primary care clinics, and social support centers. At the same time, young adults and students, who showed relatively higher awareness, can be leveraged as ambassadors for peer-education programs in universities and on social media platforms. Regional disparities should also be considered, with focused educational efforts in the central and western regions where knowledge levels were the lowest. By enhancing awareness and understanding of ocular red flag symptoms, we can strive to prevent vision loss and improve the overall eye health of individuals in Saudi Arabia. This study has several limitations. First, the use of a non-probability snowball sampling method may limit the generalizability of the results to the broader Saudi population. Second, the online distribution of the questionnaire could have excluded individuals with limited internet access or digital literacy. Third, as the questionnaire was self-reported and awareness was measured through closed-ended questions, there is a possibility of response bias or guessing. Lastly, the lack of previously validated instruments meant the questionnaire was newly developed, which, despite face and content validation, may affect its comparability with other studies. Future research should consider using a randomized sampling method to enhance generalizability and include a broader range of participants, particularly underserved or older populations. Public health authorities should develop national awareness campaigns targeting both the general public and healthcare workers, with tailored content for subgroups identified as having low awareness such as older adults, non-working populations, and residents of regions with lower knowledge levels. Additionally, incorporating ophthalmic emergency topics into primary care education and community health programs is strongly recommended.

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