ORIGINAL ARTICLE

The Knowledge Level of Retinoblastoma among the Clinical-Phase Medical Students: A Cross-Sectional Study, Basis for Improving Ophthalmology Curriculum for Future Clinical Practice

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ABSTRACT

Introduction: **Medical students play an essential role in the healthcare system. Therefore, it is crucial to measure their knowledge regarding life-threatening diseases, such as retinoblastoma. The current study aims to assess the knowledge level of retinoblastoma among the clinical-phase medical students at the University of Tabuk, Saudi Arabia.**

Methods: **This is a quantitative, cross-sectional, descriptive study using a self-administered electronic questionnaire conducted among clinical phase medical students (fourth, fifth, and sixth years) at the University of Tabuk, Saudi Arabia. A structured questionnaire was used, and eighteen questions were included to assess their knowledge level. The questionnaire started with a photo of a retinoblastoma patient, followed by questions about retinoblastoma diagnosis, signs and symptoms, causes, treatment, complications, prognosis, and related practices.**

Results: **The study included 167 participants; female students were (60%), while 40% were male students. Fourth-year medical students constituted 32% of the participants, fifth-year students were 26%, and 42% were sixth-year medical students. Around two-thirds of the participants recognized the lesion as retinoblastoma and knew that leukocoria is the most common presenting sign (62%, and 68%, respectively). Only 28% of the students chose death as the most dangerous complication of untreated retinoblastoma. 56% of the participants had a poor knowledge level about retinoblastoma, and 44% demonstrated a good knowledge level.**

Conclusion: **The medical students in the clinical years at the University of Tabuk, Saudi Arabia, showed poor knowledge about retinoblastoma. These results shed light on the importance of raising awareness about retinoblastoma and ensuring its incorporation into medical schools' curricula.**

KEY WORDS

ocular tumors, medical school, curriculum, awareness, retinoblastoma.

INTRODUCTION

Retinoblastoma is considered the most common pediatric intraocular neoplasm. Globally, retinoblastoma affects about one in every 15,000-20,000 live births, resulting in about 9000 new cases each year. Around 90% of the cases are identified in children under three[1)]. Biallelic RB1 tumor suppressor gene alterations are thought to predispose retinal progenitor cells to tumor development[2)]. There are two retinoblastoma forms: heritable and nonheritable. The first mutation in the heritable form is constitutional, while the second is somatic, resulting in bilateral illness. Both allelic mutations are somatic in the nonheritable form, restricting illness to one eye with delayed presentation compared to individuals with the heritable form[3,4)]. The most common early sign of retinoblastoma is leukocoria. Reduced vision, strabismus, and elevated eye pressure can also occur. Examination under anesthesia using ophthalmoscopy, orbital ultrasonography, and fluorescein angiography are used to confirm the diagnosis of retinoblastoma[3)] Radiologic imaging is used to determine the stage of the disease[5,6)].

As a result of early detection and better treatment options, the prognosis of retinoblastoma patients has improved. Thus, a delay in the diagnosis is a poor predictor of retinoblastoma prognosis. Patients with retinoblastoma in developed countries who have a higher socioeconomic status and better access to the advanced healthcare system were found to present with earlier stages of the disease, which leads to better survival rates compared to patients from developing countries[7,8)].

Raising awareness about retinoblastoma results in a considerable improvement in eye preservation rates[9)]. However, poor awareness in the

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Table 1: Comparison of participants' characteristics according to their retinoblastoma knowledge level (total n = 167)

		Knowledge score		Tests of significance	
		Good knowledge (score > 12) (n = 73)	Poor knowledge (score =/< 12) (n = 94)	Test statistic	p-value
Age	**Mean ± SD**	23.6 ± 1.3	23.3 ± 1.2	1.553	0.123
Gender	**Female**	46 (63.0%)	54 (57.4%)	0.530	0.467
	Male	27 (37.0%)	40 (42.6%)		
GPA	**Mean ± SD**	4.0 ± 0.5	3.8 ± 0.6	2.961	0.004*
Medical Year	**4th**	11 (15.1%)	42 (44.7%)	19.124	< 0.001*
	5th	28 (38.4%)	16 (17.0%)		
	6th	34 (46.6%)	36 (38.3%)		

n: number; SD: standard deviation; * significant at $p < 0.05$.

Table 2: Comparison of the knowledge score among the categories of respondents' characteristics (total n = 167)

		Knowledge score		Tests of significance	
		Median [IQR]	Min - Max	Test statistic	p-value
Age groups	**21 - 22 yrs**	12.0 [10.0 - 14.0]	3.0 - 17.0	0.177 a	0.915
	23 - 24 yrs	12.0 [10.5 - 14.0]	6.0 - 16.0		
	≥ 25 yrs	12.0 [10.0 - 13.0]	6.0 - 15.0		
Gender	**Female**	12.0 [11.0 - 14.0]	3.0 - 17.0	1.150 b	0.250
	Male	12.0 [9.0 - 14.0]	6.0 - 16.0		
GPA	**2.5 - 3.4**	10.0 [9.0 - 12.0]	6.0 - 15.0	12.303 a	0.002* 2.5-3.4 vs. 3.5-4.4 = 0.005* 2.5-3.4 vs. ≥ 4.5 = 0.005* 3.5-4.4 vs. ≥ 4.5 = 1.000
	3.5 - 4.4	12.0 [11.0 - 14.0]	3.0 - 16.0		
	≥ 4.5	13.0 [12.0 -14.0]	8.0 - 16.0		
Medical Year	**4th**	11.0 [10.0 -12.0]	3.0 - 16.0	17.481 a	< 0.001* Y4 vs. Y5 = 0.001* Y4 vs. Y6 = 0.001* Y5 vs. Y6 = 1.000
	5th	13.0 [11.0 - 14.0]	6.0 - 17.0		
	6th	12.0 [11.0 - 14.0]	8.0 - 16.0		

Abbreviations: IQR: interquartile range (expressed as 25th-75th percentiles); Max: maximum; Min: minimum; *: significant at $p < 0.05$; a: Kruskal-Wallis test; b: Mann-Whitney test.

Table 3: Multiple linear regression test to assess the effect of GPA and medical year on the knowledge score (total n = 167)

	B	SE	t	p-value	95.0% CI for B
GPA 3.5 - 4.4	1.233	0.494	2.493	0.014*	0.256 - 2.209
GPA ≥ 4.5	1.556	0.634	2.455	0.015*	0.304 - 2.808
5th medical year	1.429	0.486	2.943	0.004*	0.470 - 2.388
6th medical year	1.304	0.440	2.962	0.004*	0.434 - 2.173

Abbreviations: B: regression coefficient; SE: standard error of B; CI: confidence interval; *: significant at $p < 0.05$

population can lead to delayed diagnosis and poor prognosis[10). Physicians' awareness of retinoblastoma is crucial, especially pediatricians, family physicians, and primary healthcare providers. In addition, in their clinical years, medical students are important subjects to assess their knowledge about the disease[11)]. Since they are part of the healthcare system, their ability to diagnose retinoblastoma is vital for the early detection of a life-threatening eye tumor. A study conducted in Mexico showed that the lack of knowledge about the disease among medical students in their final year was one of the significant barriers to diagnosing retinoblastoma early[12)]. A similar study in Jordan concluded that medical students showed a lack of knowledge regarding retinoblastoma[11)].

Ophthalmology education in medical schools faces many problems. It is a crowded curriculum in most schools, and the challenge is to provide effective teaching[13)]. Since medical students across the globe were not prepared to provide competent ophthalmic care both in high and low-resource regions[14)]. Several strategies were investigated to enhance the impact and comprehensiveness of the ophthalmology curriculum. The first randomized control trial was conducted in the Australian medical student ophthalmology curriculum and showed that the Virtual Ophthalmology Clinic enhances student learning significantly[15)]. Moreover, Data from previous studies suggest that Virtual ophthalmology clinics improved medical students' academic performance[16)]. Sydney Medical School created a logbook as part of the revised ophthalmic curriculum. The revised ophthalmic curriculum resulted in increased academic performance and higher student satisfaction[13)]. During the COVID-19 pandemic, a virtual neuro-ophthalmology elective was created at Methodist Hospital in Houston, Texas. This virtual elective can be

Figure 1: The distribution of the retinoblastoma knowledge scores among the students

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	4,5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5
		(b) Describe any methods used to examine subgroups and interactions	5
		(c) Explain how missing data were addressed	5
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	6,7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7
		(b) Report category boundaries when continuous variables were categorized	6,7
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8,9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8,9
Generalisability	21	Discuss the generalisability (external validity) of the study results	8,9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

adaptable to other ophthalmology subspecialties[17].

Our study aims to assess the knowledge level of retinoblastoma among medical students at the University of Tabuk, Saudi Arabia, during their clinical years (fourth, fifth, and sixth years). Pediatric and ophthalmology courses were introduced in the fifth year. However, no lectures have been provided to the students covering the topic of retinoblastoma in the mentioned years.

METHODS

Ethical approval:

The research ethics committee approved the study at the University of Tabuk. Approval number (UT-161-20-2021) on 28-9-2021.

Study design, settings, and participants:

This is a quantitative, non-experimental, cross-sectional, prospective, descriptive study using a self-administered electronic questionnaire conducted among clinical phase medical students (fourth, fifth, and sixth years) at the University of Tabuk, Saudi Arabia, in 2021.

After obtaining the students' list from the Faculty of Medicine's administration, we gave each student a serial number; then, we randomly chose the representative sample (167 students) using the Number Generator[19]. Then, we contacted the selected students by email. The email included informed consent, a description of the study objectives, participation consent, and the web link for the online questionnaire. Some students did not enroll in the study, and for that, we repeated the same process to reach a representative sample.

Variables and measures:

A structured questionnaire was modified from the previous literature to collect age, gender, medical school level, and cumulative grades score (GPA)[11]. Then, the knowledge assessment starts with a photo showing a patient with retinoblastoma in one eye, followed by related questions about the seen abnormality. The 18 knowledge questions assess the knowledge level about retinoblastoma diagnosis, signs and symptoms, causes, treatment, complications, prognosis, and related practices Table 2.

Knowledge score:

The response to each question assessing knowledge was assigned zero points if the answer was incorrect and one point if the answer was correct, and the points of all questions were summed up to calculate the knowledge score for retinoblastoma for each student. The maximum score was estimated to be 18, and the minimum was zero. The total score was calculated for each student and classified into poor and good knowledge about retinoblastoma.

Sample size:

An online software was used, Raosoft, to calculate the sample size[18]. The estimated representative sample size was 167 students using the following parameters; a confidence interval of 95%, a 5% error margin, a population size of 294, and a response distribution of 50%.

Statistical analysis:

Statistical analysis was performed with the Statistical Package for Social Sciences (IBM SPSS Statistics) for Windows, version 26 (IBM Corp., Armonk, NY, USA). Normally distributed continuous numerical variables were summarized as mean ± standard deviation (SD); comparisons were made using the independent samples T-test. Abnormally distributed numerical variables were summarized as median, interquartile range (IQR, expressed as 25th-75th percentiles). Categorical variables were expressed as frequencies. We tested the associations between the groups and categorical variables using Pearson's Chi-Square test for independence, Fisher's exact test, or Fisher-Freeman-Halton exact test. A p-value < 0.05 was adopted to indicate significant differences/associations. We performed multiple linear regression to assess respondent characteristics' effect on the knowledge score.

RESULTS

The present study included 167 participants who responded to the questionnaire. The age ranged from 21 to 27 years old, with a mean of 23.4 ± 1.3 years. Female students outnumbered male students (59.9% vs. 40.1%). The respondents' GPA ranged from 2.6 to 4.6, with a mean of 3.9 ± 0.6. Approximately one-third of respondents (31.7%) were 4th year, a quarter was fifth-year students (26.3%), and the remainder (41.9%) were sixth-year students.

Regarding students' responses identifying retinoblastoma and its causes, the majority of students (97.6%) determined that the child in the picture was not healthy, the appearance was due to a disease (98.2%), and 80.2% were able to identify the diseased eye. In our study, 76% of students correctly identified the test name. The majority (96.4%) stated that if they see a similar picture of a child of their relatives, they will refer immediately to an ophthalmologist. Only 35.3% specified that this sign might indicate several ophthalmic disorders. Most students (74.3%) knew retinoblastoma runs in families, while 23.4% thought it was age-related. About 90% responded that the ophthalmologist is best suited to treat the patients. Students who heard about retinoblastoma constituted 81.4%. The most frequently chosen source of knowledge for those who heard about retinoblastoma at medical school was the most common (81%). In comparison, books and the internet accounted only for 12.5% and 6%, respectively. Approximately two-thirds (68.9%) of the participants chose leukocoria as the most common presenting sign. Less than half the respondents (49.1%) knew that the diagnosis is principally through fundus examination. The role of MRI in the diagnosis was known by 83.8%. The accepted waiting time before looking for the incipient signs of retinoblastoma in a child with a family history was estimated by 37.1% to be six months. In comparison, 29.3% said that within the first week of life, 19.8% chose the age at which the affected family member was diagnosed. Only 28.1% of students recognized that retinoblastoma is fatal if left untreated, while 64.1% thought that the worst prognosis is blindness. According to the latter question, only 47.9% of students stated that observation is not among the treatment modalities. Most students (73.7%) thought that treatment of retinoblastoma should take place in a specialized center, while 21% believed that any eye hospital is qualified to manage the disease. King Khalid Eye Specialist Hospital was recognized by 74.9% of students as the best center in Saudi Arabia to treat retinoblastoma. Only about half the students (58.7%) agreed that a prosthetic eye could improve cosmetic appearance after enucleation in those patients. On the other hand, 16.8% thought it was unavailable in Saudi Arabia, 15% thought it could improve visual acuity, and 9.6% thought it was contraindicated to avoid tumor recurrence.

The knowledge score was calculated and ranged from 3 to 17, with a median of 12 and an IQR of 10 4. Figure 1 illustrates a histogram of the knowledge score of the respondents. The respondents were categorized into two groups based on the median score: a good knowledge group (score > 12) consisting of 73 students (44%) and a poor knowledge group (score ≤ 12) that has 94 students (56%).

Table 1 compares the two groups regarding the respondents' characteristics. There was no statistically significant difference between the two groups in the age or gender distribution (p = 0.123 and 0.467, respectively). However, the good knowledge group had a significantly higher mean GPA (4.0 ± 0.5 vs. 3.8 ± 0.6, p = 0.004) and a higher percentage of students in the advanced years (5th year: 38.4% vs. 17% and 6th year: 46.6% vs. 38.3%, p < 0.001).

Table 2 compares the knowledge scores among the categories of the respondents' characteristics. The findings confirmed the results presented in table 1, where no significant difference was detected among the age groups (p = 0.915) or gender (p = 0.250). The categories of GPA showed significant differences as students with GPAs of 2.5 — 3.4 had a significantly lower median knowledge score than those with GPA of 3.5 — 4.5 (Median: 10 vs. 12, p = 0.005) and those with GPA ≥ 4.5 (Median: 10 vs. 13, p = 0.005). In addition, students in the fourth medical year had a significantly lower median knowledge score than those in the fifth year (Median: 11 vs. 13, p = 0.001) and those in the 6th year (Median: 11 vs. 12, p = 0.001).

Multiple linear regression was conducted to assess the respondents' significant characteristics in the univariate analysis, i.e., the GPA and medical year (Table 3). GPA 3.5 - 4.4 and GPA ≥ 4.5 were significantly associated with an increase in the knowledge score (B = 1.233, 95% CI: 0.256 - 2.209, p = 0.014 and B = 1.556, 95% CI: 0.304 - 2.808, p = 0.015, respectively). Being in the fifth or sixth medical year was also significantly associated with an increase in the knowledge score (B =

1.429, 95% CI: 0.470 - 2.388, p = 0.004 and B = 1.304, 95% CI: 0.434 - 2.173, p = 0.004, respectively).

DISCUSSION

Retinoblastoma is a life-threatening eye disease. It is the most prevalent ocular tumor that affects the pediatric age group[20)]. In Saudi Arabia, retinoblastoma was reported as the most common orbital tumor in the pediatric population. In 2014 an incidence of 7.7 per million/year was reported [21-23)].

The study aimed to assess the knowledge level of retinoblastoma among medical students at the University of Tabuk, Saudi Arabia, during their clinical years. The evidence from this study showed that more than half of our medical students in their clinical years have poor knowledge about retinoblastoma. Students at a higher level and those with a higher GPA were likely to have higher knowledge. In contrast, lower knowledge scores were significantly associated with low GPA and fourth year. Moreover, knowledge sources were variable, but it is interesting to note that one participant had one family member as a source of his knowledge about the disease. This is the first study to identify the level of knowledge among medical students at Tabuk University, Saudi Arabia. This study can provide recommendations to improve the level of knowledge among medical students at the University of Tabuk, Saudi Arabia.

Lower knowledge scores were found in the fourth year, which might be explained by the fact that fourth-year students still did not enroll in the pediatric curriculum. As part of the pediatric examination, students were introduced to leukocoria as an abnormality that retinoblastoma can cause.

Our results show similarity to other studies reporting low knowledge among medical students[11,12)]. In a study conducted in Jordan, Yousef *et al*. (2019) reported poor overall knowledge of retinoblastoma among medical students. Leukocoria was not recognized by medical students 62 (45%) as a sign of a life-threatening disease[11)]. This outcome is contrary to our results. 115 (68%) students identified leukocoria. These results reflect those of Ramirez-Ortiz M *et al*. (2017) who also found that (53.9%) of students knew the most common sign[24)]. Additionally, Yousef *et al*. (2019) showed that 52 (80%) of students identify death as the most dangerous complication that might happen. This finding differs from the findings presented here, whereas 107 (64%) students in our study thought it was blindness.

Furthermore, Abdallah Y. Naser *et al*. (2021) found that age, gender, and level of education were significantly associated with knowledge level. Being male with lower education is a significant predictor of lower retinoblastoma knowledge[10)]. While in our study, higher levels of education and GPA were the only significant predictors of knowledge level.

Despite most Saudi medical schools following the ICO guidelines, as numerous graduates are competent in many basic ophthalmic skills, these findings emphasize the importance of raising knowledge in medical students, and it can be achieved by modifying a teaching curriculum that focuses on the red flags of retinoblastoma, including retinoblastoma topics in various medical schools' modules to ensure they graduate with adequate knowledge to detect and diagnose retinoblastoma and prevent lifelong consequences early[25)].

There is a list published by The International Council of Ophthalmology (ICO) that contains conditions that graduated medical students should be able to diagnose, treat and do referral plans, including the Leukocoria approach, which enhances the importance of adding the retinoblastoma topic into the medical school curriculum as suggested above[26)].

Limitations:

Our study had some limitations; the self-administered nature of the responses may lead to misclassification bias. Additionally, our study was performed only at one university; thus, the generalizability of the results to all the medical schools in Saudi Arabia may be affected.

CONCLUSION

Retinoblastoma knowledge among medical students in the clinical years at the University of Tabuk, Saudi Arabia, is suboptimal. This conclusion emphasizes the importance of raising awareness about this disease and ensuring the incorporation of retinoblastoma topics in several modules in medical schools' curricula.

WHAT IS KNOWN ON THIS TOPIC

- Retinoblastoma is a life-threatening ocular tumor.
- Medical students should be knowledgeable about life-threatening diseases.

WHAT THIS STUDY ADDS

- Medical students have a poor level of knowledge regarding retinoblastoma.
- The importance of including retinoblastoma in the medical school curriculum.

COMPETING INTEREST

The authors declare no competing interest.

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