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ASSOCIATION BETWEEN MYOPIA AND THE ABO/RH BLOOD GROUPS AMONG COLLEGE OF SCIENCE STUDENTS, KNUST

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ABSTRACT

Purpose: *This cross-sectional study sought to determine the association between ABO/Rh blood groups and myopia among adults in Ghana*

Methods: *This study was conducted among randomly selected 407 students at the College of Science, Kwame Nkrumah University of Science and Technology. Non-cycloplegic objective refraction using an autorefractor was used to determine the refractive status. ABO/Rh blood groups were determined using the tile method. Data was entered and cleaned with Microsoft Excel Version 16.0 and analyzed with Stata Version 15 employing Pearson's Chi-square test of association and Fisher's exact tests to ascertain the association between myopia and ABO/Rh blood groups. Statistical significance was defined as a p-value < 0.05 and 95% confidence interval.*

Results: *A total of 310 students participated in the study, out of which 169 (54.52%) were females and 141 (45.48%) were males. The average (±SD) age of the students was 21.30 (±2.06). The mean spherical equivalent measurements (±SD) for emmetropes, myopes and hyperopes were +0.01D (±0.26), -1.51D (±1.25) and +0.85D (±0.79), respectively. Myopia prevalence was 34.19%. The blood group prevalence in the population was O, B, A, and AB, with Rh+ being more common than Rh-. The chi-square test indicated no significant correlation between myopia and ABO or Rh blood groups (p-values of 0.381 and 0.0802, respectively).*

Conclusion: *While our research did not find any significant correlation between myopia and ABO/Rh blood groups, we observed intriguing patterns of refractive errors and blood groups distribution influenced by various factors.*

Keywords: myopia, ABO/Rh, blood group, risk factor

INTRODUCTION

There are an estimated 252.6 million people worldwide with visual impairments, defined as having a best-corrected visual acuity of 6/18 (20/60) or worse in their better-seeing eye (95% CI, 111.4 – 424.5). (Bourne *et al*., 2017). The leading causes of vision impairment and blindness across the world are refractive errors and cataracts (WHO, 2019). Uncorrected refractive errors, particularly myopia (nearsightedness), have emerged as a significant global public health concern (WHO, 2019). According to the World Health Organization (WHO), myopia affects approximately 2.6 billion people worldwide, with projections indicating that this number could increase to about half of the world's population by 2050 (WHO, 2019). About one billion of these cases could have been avoided or remain unresolved (WHO, 2019). Myopia occurs when light rays entering the eye parallel to the optic axis are focused in front of the retina, either due to the elongation of the eyeball (axial myopia) or changes in the structure of the cornea and lens (refractive myopia) (Remington, 2012).

Risk factors for myopia development and progression include prolonged near work, reduced outdoor time, gender, race, and genetics (Cao *et al*., 2020). Individuals with myopia are at risk of developing bilateral low vision, myopic macular degeneration, cataract, and open-angle glaucoma (Haarman *et al*., 2020). The prevalence of myopia varies across different populations, with East and South Asia reporting the highest rates, followed by Europe and North America (Spillmann, 2020), while South America and Africa record the lowest prevalence rates (Grzybowski *et al*., 2020). In Ghana, myopia prevalence among school children is estimated to be 3.2%, and among young adults, approximately 25.08% (Kumah *et al*., 2013, Kumah *et al*., 2016).

The impact of myopia extends beyond visual impairment, affecting the quality of life and productivity of individuals. Long-term complications from myopia can result in reversible and irreversible visual impairment, leading to significant economic costs estimated at around $250 billion worldwide (Naidoo *et al*., 2019). Emotional distress is also experienced by individuals and their families. The management and treatment of myopia incur high economic costs, estimated to be around $358.7 billion globally (Holy *et al*., 2019).

The ABO and Rh blood group systems, which play a crucial role in blood transfusion, have also been associated with various systemic and ocular conditions, including myopia (Mrugacz *et al*., 2009). Studies have shown that blood groups B and O are associated with the development of myopia (Gupta and Nishi, 2013, Sana *et al*., 2019). However, most of these studies have been conducted in Asia and thus their results could have been affected by race or geographical location thus the need to assess this relationship among Africans. There is also paucity of data on the association between myopia and the ABO/Rh blood group systems in Africa (Haarman *et al*., 2020). The aim of this study was to investigate the possible association between myopia and the ABO/Rh blood group system among Ghanaians. The findings of this research shed light on the relationship between myopia and blood groups in Africa, and serve as a foundation for further studies in this field. Furthermore, these results have important implications for improving eye care services, promoting preventive measures, and informing stakeholders and policymakers about the importance of early screening and treatment of myopia.

METHODOLOGY

The study was conducted at the Optometry Eye Clinic of the Department of Optometry and Visual Science within the Aboagye Menyeh Complex, College of Science in KNUST.

The study population included students from the College of Science, which has a student population of 9,757 according to the records from the University Registrar at the time of the study. The study adopted a cross-sectional study design and used simple random sampling technique to select the participants. Cochran's formula was used to calculate a sample size of 407 from a student population of 9,757. Data was gathered by administering a questionnaire that comprised of three sections. The first section included questions related to socio-demographic details and history pertaining to the eye. The second section collected patient blood information while the third section was designed for examiners to record the tests and investigations conducted. Data collection tools included a 6m Snellen visual acuity (VA) chart, Topcon KR-800 autorefractor/keratometer, single-use non-sterile gloves, 2.2mm lancet, blood collection tubes, antiseptic (70% isopropyl alcohol wipes or swabs), cotton wool, puncture-proof sharps disposal container, anti-sera A, B, and D, glass slides and wooden spatulas.

Participants were provided with a questionnaire to fill out information about their sociodemographics, ocular history, and blood history. One investigator then measured the distance visual acuity using a 6m Snellen visual acuity chart while the other investigator determined the objective refraction using a Topcon KR-800 autorefractor/keratometer. After refraction, a medical laboratory scientist used finger-prick (capillary sampling) to draw blood and collect it onto glass slides. Anti-sera A, B, and D were added to the drops of blood to determine the ABO/Rh blood groups by the tile method. All data collected were recorded in section three of the questionnaire.

Appropriate safety and prevention protocols were ensured to prevent any potential risks such as eye fatigue, bruises or pain from the trial frame, allergic reaction to tools or reagents for taking blood samples, pain or infection at the blood sampling site, hematoma (bleeding), and exposure to blood-borne microorganisms. Ethical clearance was sought from the Committee on Human Research, Publication, and Ethics (CHRPE/AP/364/22) of KNUST before conducting this research. Gatekeeper letters were sent to the heads of the Optometry clinic and the Clinical Analyses (CAn) laboratory. Informed written consent was sought from selected students before participation in the study and the study conformed to the tenets of the Declaration of Helsinki.

Data was entered and cleaned using Microsoft Excel Version 16.0 and then exported into Statistical Software for Data Science (StataCorp. 2019. Stata Statistical Software for Windows: Release 16, College Station, TX: StataCorp LLC) for analysis. Descriptive statistics including measures of central tendencies, frequencies, tabulations, and graphical representation were explored. Test of association between categorical variables was done using Pearson chi-square/Fischer's exact test. Correlation analysis was performed on continuous variables using pairwise correlation and t-test. A p-value of less than 0.05 at 95% confidence intervals was considered significant.

RESULTS

Demographic Characteristics of Participants

A total of 310 students participated in the study, with 169 (54.52%) females and 141 (45.48%) males. The mean (±SD) age of the participants was 21.30 (±2.06) years. The table below shows the demographic characteristics of the participants.

Table 1: Socio-Demographic Characteristics of Participants

Variable	n (%)
Age Group	
18-21	186 (60.00)
22-25	116 (37.42)
26-29	6 (1.94)
30-33	1 (0.32)
34-36	1 (0.32)
Sex	
Male	141 (45.48)
Female	169 (54.52)
Year of Study	
Year 1	17 (5.4)
Year 2	117 (37.74)
Year 3	69 (22.26)
Year 4	84 (27.10)
Year 5	22 (7.10)
Year 6	1 (0.3)
Faculty	
Physical and Computational Sciences	132 (42.58)
Biosciences	178(57.42)

n = number of participants, % = Percentage of participants

Refractive Status

The mean (±SD) spherical equivalent measures of emmetropes, myopes and hyperopes were 0.01DS (±0.26), -1.51DS (±1.25), and +0.85DS (±0.79) respectively. The overall prevalence of myopia was 34.19%. The table below shows the distribution of refractive status among the participants. Table 2 below displays the distribution of refractive errors among the participants.

Table 2: Distribution of Refractive Status among Participants

Refractive Status	n	Mean	SD	%
Emmetropia	144	0.226	0.296	46.45
Myopia	106	-1.196	1.194	34.19
Hyperopia	60	0.979	0.847	19.35
Spherical Equivalence				
Emmetropia	144	0.010	0.262	46.45
Myopia	106	-1.507	1.249	34.19
Hyperopia	60	0.854	0.790	19.35

The refractive status was further divided into myopes and non-myopes and their distribution among faculties and years of study are shown in Tables 3 & 4.

Table 3: Distribution of myopia status among faculties

Myopia Status	n	%
Non-Myope	204	65.81
Myope	106	34.19
Distribution of non-myopes among faculties		
Biosciences	119	58.33
Physical and Computational Sciences	85	41.67
Distribution of Myopes among faculties		
Biosciences	59	55.66
Physical and Computational Sciences	47	44.34

Table 4: Distribution of myopia status among the year of study

Myopia Status	Year of Study						
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Non myope	12	82	37	57	15	1	204
Myope	5	35	32	27	7	0	106

ABO/Rh Blood Groups of Participants

There are 4 blood groups under the ABO system and 2 main groups under the Rhesus factor blood group system. A combination of these 2 blood groups gives 8 major blood groups. Figures 1, 2 and 3 shows the distribution of the various blood groups among the students in CoS.

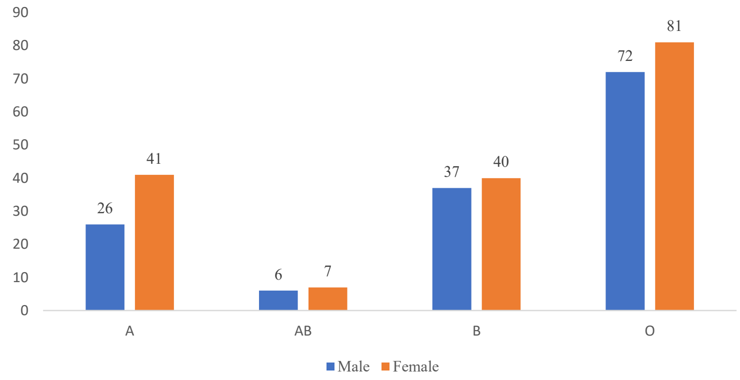

Fig. 1: The distribution of ABO blood group across gender

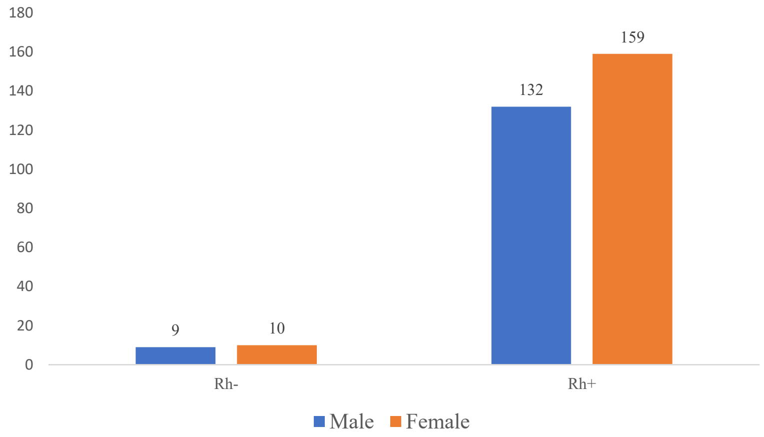

Fig. 2: The distribution of Rh blood group across gender

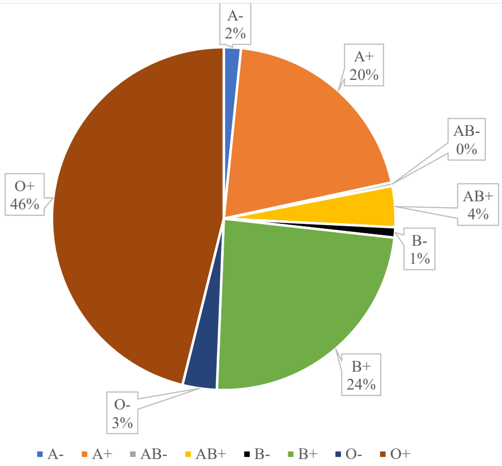

Fig. 3: The distribution of ABO/Rh blood groups among Participants

Association between Myopia and ABO/Rh Blood Groups Among Participants

The number of myopes in each blood group was lower as compared to the number of non-myopes. So, overall, the number of non-myopes was higher than myopes. Chi-square test of association explored the association between myopia and the ABO blood group and it revealed $X^2=3.07$, $p=0.381$ For the association between myopia and Rh blood group, it revealed $X^2=0.0631$, $p=0.802$.

Table 5: Distribution between myopia status and blood group

Blood Group ABO System	Non-myope	Myope	Total	Percentage (%)
A	41	26	67	21.61
AB	11	2	13	4.19
B	53	24	77	24.84
O	99	54	153	49.36
Rh System				
Rh-	12	7	19	6.13
Rh+	192	99	291	93.87
Total	204	106	310	100.00

DISCUSSION

The primary objective of this study was to ascertain the association between myopia and ABO/Rh blood groups. Our investigation revealed no statistically significant correlation between myopia and ABO/Rh blood groups, aligning with the outcomes of other studies such as those conducted by Gaonkar *et al*. (2020), Zahra and Hussain (2016) and Ved *et al*. (1979). Comparable to our findings, research that identified a significant association between myopia and ABO/Rh blood groups tended to have larger sample sizes (>180 myopes) as seen in the studies by Sana *et al*. (2019) and Gupta and Nishi (2013), whereas our study identified only 106 myopes.

It is worth noting that our study observed a unique distribution of refractive conditions among participants, deviating from the usual findings of studies conducted among tertiary students. Specifically, we found that emmetropes comprised the largest group, followed by myopes and hyperopes. In contrast, previous research conducted in academic settings has typically indicated a higher prevalence of myopia, followed by emmetropia and hyperopia. This variance has been attributed to a range of factors such as ethnicity, familial history, and the intensity of education. (Shneor *et al*., 2022, Abuallut *et al*., 2020, Wei *et al*., 2018). The relatively low prevalence of myopia in our study could potentially be due to the higher proportion of non-myopic participants.

In our observations, astigmatism was the most prevalent refractive error pattern among students, with compound myopic astigmatism being the most common form (36.60%) and pure spherical errors being rare. This aligns with a study by Dobson *et al*. (2007) who indicated changing trends in astigmatism with age, often accompanied by an increase in myopic astigmatism. Notably, increasing astigmatism has been associated with accelerated myopia progression in children, possibly due to the impact of astigmatic blur during emmetropization Fan *et al*. (2004), which could be a contributing factor to the high prevalence of myopic astigmatism (48.69%) observed in our study (Gwiazda *et al*., 2000).

Our study also unveiled gender-based differences in myopia prevalence, with more females identified as myopes. This observation could be influenced by the higher female participation rate in our study. This trend was consistent with reports from Taiwan National Health Interview Survey and French studies that highlighted a higher prevalence of myopia in younger individuals, particularly females (Xiang and Zou, 2020). Factors such as education level, near work engagement, and earlier puberty onset in females might contribute to this gender-based difference in myopia prevalence (Saw *et al*., 2002)

In relation to ABO/Rh blood groups, we observed a distinct distribution pattern in our study. The blood group O+ had the highest representation, followed by B+, A+, AB+, O-, A-, B-, and AB-. This pattern closely aligns with previous African studies, with only a slight deviation seen in the higher prevalence of A- blood group compared to B- in our study (Doku *et al*., 2022, Sawadogo *et al*., 2019). In contrast, patterns seen in China Liao and Li (2020) and India Behra and Joshi (2013) exhibit different sequences. Genetic and environmental factors might contribute to these variations in ABO/Rh blood group distributions. The high prevalence of blood group O, being a universal donor, is advantageous for emergency blood transfusions.

Remarkably, most myopes in our study belonged to blood group O (50.94%), followed by A (24.53%), B (22.64%), and AB (1.89%), with the majority of myopes being Rh+. In India and Pakistan, studies reported similar but varying sequences of blood group prevalence among myopes (Sana *et al*., 2019, Zahra and Hussain, 2016). These regional disparities could be attributed to geographical and genetic influences.

Our study's myopia prevalence (34.19%) exceeded the rates reported by Kumah *et al*. (2016) and Abdul-Kabir *et al*. (2016) in Ghana, which might be due to the use of tertiary students as subjects who often engage in prolonged near work and screen time (Cao *et al*., 2020). However, this difference could also be influenced by the non-cycloplegic refraction method, potentially overestimating results as suggested by (Morgan *et al*., 2015, Fotouhi *et al*., 2012).

Significantly, we established a strong association ($p<0.01$) between knowledge of myopia and myopic status, indicating that a substantial number of myopes were unaware of their refractive status and didn't use corrective measures. This observation resonated with findings from studies in Nigeria, Ebeigbe *et al*. (2013) and Saudi Arabia, Almujalli *et al*. (2020), reinforcing the need for increased awareness and intervention to manage myopia among tertiary students.

In summary, this study provides valuable insights into the intricate relationship between myopia, ABO/Rh blood groups, and refractive conditions. While no significant association was found between myopia and ABO/Rh blood groups, the prevalence of refractive errors and blood groups exhibited intriguing patterns influenced by demographic and genetic factors. Our findings underscore the importance of heightened awareness and targeted interventions to address the growing prevalence of myopia among tertiary students.

CONCLUSION

Our investigation into the potential association between ABO/Rh blood groups and myopia among adult Ghanaians yielded a notable finding, in that, no significant correlation was observed between these variables. This main result highlights the need for further research to shed light on the intricate factors influencing myopia development.

LIMITATIONS

Several limitations were identified in this study that merit consideration. The relatively smaller sample size of myopic students compared to non-myopes might have influenced the absence of an observed association between myopia and ABO/Rh blood groups. The use of a non-cycloplegic refraction method for assessing participants' refractive statuses introduces the possibility of underestimating or overestimating refractive powers.

RECOMMENDATIONS

The findings of this study underscore the significance of education and awareness in addressing the escalating prevalence of myopia. A significant correlation was observed between lack of knowledge regarding refractive errors and the presence of myopia. Similarly, individuals not wearing corrective spectacles exhibited myopia. These findings collectively contribute to the rising myopia prevalence. It is recommended that students be educated about the importance of regular eye examinations conducted by professional eye care practitioners. Given the heavy involvement of students in near-work activities, proactive measures are vital to curbing the progression of myopia.

In summary, the urgency of combating myopia's upward trajectory necessitates a multifaceted approach, combining awareness, education, and comprehensive eye care. By addressing modifiable risk factors and conducting extensive research, clinicians and researchers can collaborate to curb myopia's prevalence and enhance ocular health on a global scale. This study offers a foundation upon which future interventions can be built to counteract the pervasive challenge of myopia.

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REFERENCES

ABDUL-KABIR, M., BORTEY, D. N. K., ONOIKHUA, E. E., ASARE-BEDIAKO, B. & KUMAH, D. B. 2016. Ametropia among school children-A cross-sectional study in a sub-urban municipality in Ghana. Paediatric Diamensions, 1, 65-68.

ABUALLUT, II, ALHULAIBI, A. A., ALYAMANI, A. A., ALMALKI, N. M., ALRAJHI, A. A., ALHARBI, A. H. & MAHFOUZ, M. S. 2020. Prevalence of Refractive Errors and its Associated Risk Factors among Medical Students of Jazan University, Saudi Arabia: A Cross-sectional Study. *Middle East Afr J Ophthalmol,* 27**,** 210-217.

ALMUJALLI, A. A., ALMATRAFI, A. A., ALDAEL, A. A., ALMOJALI, H. A., ALMUJALLI, A. I. & PATHAN, A. 2020. Knowledge, attitude, and practice about myopia in school students in Marat city of Saudi Arabia. *J Family Med Prim Care,* 9**,** 3277-3280.

BEHRA, R. & JOSHI, Y. 2013. Distribution of ABO blood group and RH (D) factor in Western Rajasthan. *National journal of medical research,* 3**,** 73-75.

BOURNE, R. R. A., FLAXMAN, S. R., BRAITHWAITE, T., CICINELLI, M. V., DAS, A., JONAS, J. B., KEEFFE, J., KEMPEN, J. H., LEASHER, J., LIMBURG, H., NAIDOO, K., PESUDOVS, K., RESNIKOFF, S., SILVESTER, A., STEVENS, G. A., TAHHAN, N., WONG, T. Y. & TAYLOR, H. R. 2017. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *Lancet Glob Health,* 5**,** e888-e897.

CAO, K., WAN, Y., YUSUFU, M. & WANG, N. 2020. Significance of Outdoor Time for Myopia Prevention: A Systematic Review and Meta-Analysis Based on Randomized Controlled Trials. *Ophthalmic Res,* 63**,** 97-105.

DOBSON, V., HARVEY, E. M. & MILLER, J. M. 2007. Spherical equivalent refractive error in preschool children from a population with a high prevalence of astigmatism. *Optom Vis Sci,* 84**,** 124-30.

DOKU, G. N., AGBOZO, W. K., ANNOR, R. A., MAWUDZRO, P. E. & AGBELI, E. E. 2022. Frequencies and ethnic distribution of ABO and RhD blood groups in the Volta region of Ghana, towards effective blood bank services. *Afr Health Sci,* 22**,** 641-647.

EBEIGBE, J. A., KIO, F. & OKAFOR, L. I. 2013. Attitude and beliefs of Nigerian undergraduates to spectacle wear. *Ghana Med J,* 47**,** 70-3.

FAN, D. S., RAO, S. K., CHEUNG, E. Y., ISLAM, M., CHEW, S. & LAM, D. S. 2004. Astigmatism in Chinese preschool children: prevalence, change, and effect on refractive development. *Br J Ophthalmol,* 88**,** 938-41.

FOTOUHI, A., MORGAN, I. G., IRIBARREN, R., KHABAZKHOOB, M. & HASHEMI, H. 2012. Validity of noncycloplegic refraction in the assessment of refractive errors: the Tehran Eye Study. *Acta Ophthalmol,* 90**,** 380-6.

GAONKAR, S. R., NALINI, Y. C., NIBEDITA, A. & ANJUSHA, I. B. 2020. ABO blood groupdistribution and its association with myopia among first year medical students in Bangalore-A cross sectional study. International Journal of Contemporary Medical Research, 7, e1-e3.

GRZYBOWSKI, A., KANCLERZ, P., TSUBOTA, K., LANCA, C. & SAW, S. M. 2020. A review on the epidemiology of myopia in school children worldwide. *BMC Ophthalmol,* 20**,** 27.

GUPTA, N. K. & NISHI, K. 2013. A study on the incidence of myopia and hypermetropia in ABO blood groups. *National Journal of Life Science,* 10**,** 31-33.

GWIAZDA, J., GRICE, K., HELD, R., MCLELLAN, J. & THORN, F. 2000. Astigmatism and the development of myopia in children. *Vision Research,* 40**,** 1019-1026.

HAARMAN, A. E. G., ENTHOVEN, C. A., TIDEMAN, J. W. L., TEDJA, M. S., VERHOEVEN, V. J. M. & KLAVER, C. C. W. 2020. The Complications of Myopia: A Review and Meta-Analysis. *Invest Ophthalmol Vis Sci,* 61**,** 49.

HOLY, C., KULKARNI, K. & BRENNAN, N. A. 2019. Predicting Costs and Disability from the Myopia Epidemic–A Worldwide Economic and Social Model. *Investigative Ophthalmology & Visual Science,* 60**,** 5466-5466.

KUMAH, B. D., EBRI, A., ABDUL-KABIR, M., AHMED, A.-S., KOOMSON, N. Y., AIKINS, S., AIKINS, A., AMEDO, A., LARTEY, S. & NAIDOO, K. 2013. Refractive error and visual impairment in private school children in Ghana. *Optometry and Vision Science,* 90**,** 1456-1461.

KUMAH, D. B., AGGREY, N. J., AFOAKWAH, P., NELSON-AYIFAH, D., ANKAMAH, E. & OSAE, E. A. 2016. Prevalence of myopia among senior high school students in the Kumasi metropolis. JOJ Ophthalmology, 1, 555566

LIAO, H. & LI, J. 2020. Distribution characteristics of ABO and RhD blood groups among the voluntary blood donors in Chongqing: A retrospective study. Medicine, 99, e22689

MORGAN, I. G., IRIBARREN, R., FOTOUHI, A. & GRZYBOWSKI, A. 2015. Cycloplegic refraction is the gold standard for epidemiological studies. *Acta Ophthalmol,* 93**,** 581-5.

MRUGACZ, M., RYDZANICZ, M., FRAJDENBERG, A., PODFIGURNA-MUSIELAK, M. & GAJECKA, M. 2009. [Myopia in systemic disorders]. *Klin Oczna,* 111**,** 84-8.

NAIDOO, K. S., FRICKE, T. R., FRICK, K. D., JONG, M., NADUVILATH, T. J., RESNIKOFF, S. & SANKARIDURG, P. 2019. Potential Lost Productivity Resulting from the Global Burden of Myopia: Systematic Review, Meta-analysis, and Modeling. *Ophthalmology,* 126**,** 338-346.

REMINGTON, L. A. 2012. Clinical Anatomy and Physiology of the Visual System. St. Louis: Butterworth-Heinemann, pp 3-5.

SANA, S., KHAWAR, S., UMAIR, H. M., NAVEED, G. & RAO, M. 2019. Association between blood groups and myopia among medical students of fatima jinnah medical university. *Proceeding S. Z. P. G. M. I.,* 33**,** 30-34.

SAW, S. M., CHUA, W. H., HONG, C. Y., WU, H. M., CHIA, K. S., STONE, R. A. & TAN, D. 2002. Height and its relationship to refraction and biometry parameters in Singapore Chinese children. *Invest Ophthalmol Vis Sci,* 43**,** 1408-13.

SAWADOGO, S., NEBIE, K., MILLOGO, T., KAFANDO, E., SAWADOGO, A. G., DAHOUROU, H., TRAORE, F., OUATTARA, S., OUEDRAOGO, O., KIENOU, K., DIEUDONNE, Y. Y. & DENEYS, V. 2019. Distribution of ABO and RHD blood group antigens in blood donors in Burkina Faso. *Int J Immunogenet,* 46**,** 1-6.

SHNEOR, E., DORON, R., OSTRIN, L. A. & GORDON-SHAAG, A. 2022. The prevalence of refractive errors in college students in Israel. *J Optom,* 15**,** 284-292.

SPILLMANN, L. 2020. Stopping the rise of myopia in Asia. *Graefes Arch Clin Exp Ophthalmol,* 258**,** 943-959.

VED, L. B., GOKHALE, P. S. & RANADE, V. G. 1979. Myopia and blood groups. *Indian J Ophthalmol,* 27**,** 33-4.

WEI, S., SUN, Y., LI, S., HU, J., YANG, X., LIN, C., CAO, K., DU, J., GUO, J., LI, H. & WANG, N. 2018. Refractive Errors in University Students in Central China: The Anyang University Students Eye Study. *Invest Ophthalmol Vis Sci,* 59**,** 4691-4700.

WHO 2019. World report on vision. Geneva: World Health Organization.

XIANG, Z. Y. & ZOU, H. D. 2020. Recent Epidemiology Study Data of Myopia. *J Ophthalmol,* 2020**,** 4395278.

ZAHRA, M. & HUSSAIN, A. 2016. Association between blood groups and refractive errors. *Ophthalmology Pakistan,* 6.