Journal of Science and Technology, Vol 44 No. 2 (2026), pp. 1 - 10
Kwame Nkrumah University of Science and Technology (KNUST)
https://dx.doi.org/10.4314/just.v44i2.1

PREVALENCE OF ANISEIKONIA AMONG STUDENTS WEARERS OF CORRECTIVE SPECTACLES AND PSEUDOPHAKES IN THE KUMASI METROPOLIS

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ABSTRACT
In clinical practice in Ghana, aniseikonia is often neglected due to its assumed low prevalence. Therefore, we conducted a study to determine the prevalence of Aniseikonia in the Kumasi Metropolis. The study was conducted among the spectacle wearing population and the pseudophakia in the Kwame Nkrumah University of Science and Technology (KNUST), KNUST Junior High School and Sunshine Ophthalmic Consult. A total of 178 participants were recruited for the study. Anisometropia was measured using subjective refraction. A total of 178 participants were enrolled into the study and the Aniseikonia Inspector Software Version 3.0 was used to calculate the amount of aniseikonia. The mean (±SD) age of all respondents was 22.6 (±12.02) years with minimum and maximum ages of 13 and 79 years respectively. Twenty- two cases of aniseikonia were identified. The highest percentage of aniseikonia was recorded among the 27 and above years age group. The point prevalence of aniseikonia in the Kumasi Metropolis in 2022 was 12.5%. Aniseikonia is likely to be present in patients with corrected anisometropia and corrected pseudophakic patients since the optical correction for anisometropia can cause aniseikonia. Optometrists and other eye care professionals should consider evaluating their patients for aniseikonia when other causes of asthenopia and fusion problems have been ruled out. With the rise in cataract surgeries among the aging population, the incidence of aniseikonia among corrected pseudophakia is on the rise. Hence there should be more interest in its management among eye care professionals.

Keywords: Aniseikonia, prevalence, Kumasi, anisometropia, pseudophakia.

INTRODUCTION

Aniseikonia occurs when there is a difference in an image's perceived size or shape and is often caused by anisometropia, which is a difference in refractive error(Stokkermans and Day,2022). When aniseikonia is caused by anisometropia, it is called optical aniseikonia. Aniseikonia can also be caused by changes in the shape and location of the macula and is then called retinal aniseikonia(Stokkermans and Day,2022).

Aniseikonia is a binocular vision disorder in which images perceived by the two eyes differ in size and/or shape. In the context of anisometropia, aniseikonia can result from inherent anatomical differences (axial length and/or refractive components within the eye), differences in photoreceptor spacing between eyes, and cortical adaptations. (South et al., 2020). While aniseikonia is often defined as merely the difference in retinal image size between the two eyes, Borish (2006) suggested a change of definition to reflect that it is more of a difference in perceived image size rather than physical size (South et al., 2019). When the size difference causes symptoms—usually 0.75% or more—it is termed clinically significant aniseikonia. Clinicians typically associate aniseikonia with changes in optical or refractive magnification between the eyes brought on by anisometropia, which can be either innate or acquired after cataract surgery or corneal refractive surgery. (Rutstein and Currie, 2019).

Although smaller differences in image size are quite common, they are not usually clinically significant. It is estimated that, globally, between 20% and 30% of the general spectacles wearing population have a measurable amount of aniseikonia, but clinically significant aniseikonia (about 1% or more) is found in 3% to 5% of the population (Amos, 1987). There does not appear to be a difference in prevalence for gender, ethnicity or age. The symptoms of aniseikonia can be severe. Depending upon the degree of aniseikonia, and individual tolerance of the condition, traditionally designed glasses can cause headaches, dizziness, eye strain, fatigue and non-adaptation of the glasses. Aniseikonia can also lead to reading difficulties (Bannon and Triller, 1994). Binocular vision is affected in aniseikonia. A symptom more diagnostic of aniseikonia is a disturbance in spatial perception: the floor appears to slope, or other horizontal objects appear tilted when looking through the new glasses. Most aniseikonia arises from the difference in spectacle magnification that accompanies anisometropic corrections or acquired optical aniseikonia (Bruce, 2022). Physiologically, aniseikonia appears to be automatically compensated and gives rise to no symptoms (Bruce, 2022).

and 5% or more significantly reduces binocular contrast sensitivity and binocular summation (Jimenez et al., 2019). However, presently, it is not routinely screened for in the majority of our optometric settings. Considering that the anatomical differences causing anisometropia can result in an alteration in the sizes of retinal images and refractive correction for anisometropia can produce further variations (to) in retinal image size, it can be postulated that aniseikonia prevalence would follow anisometropia prevalence. The prevalence of anisometropia tracks a U-shaped outline across a lifetime. In the first few weeks of birth, anisometropia of more than or equal to one dioptre in spherical equivalent is very common (South et al., 2019).

Then, with emmetropization in early childhood, the prevalence declines. According to current estimates, two to five percent of the school-aged population are affected by anisometropia. This condition surges following myopia's onset in adolescence. Within the ages of twenty to forty (years), the prevalence becomes stable at around ten percent. With the onset of presbyopia, the prevalence

increasingly rises to thirty to forty percent (South et al., 2019). There is not adequate literature on the prevalence of aniseikonia in Ghana. Hence, it is imperative that more studies (are)be conducted to estimate its prevalence so that appropriate measures can be taken to manage aniseikonia. This will result in a better quality of life for affected individuals since their binocular vision will improve, enabling them to go about their daily activities without any visual disturbances. Although a lot of studies have been reported on the subject of aniseikonia, few have been conducted in Africa.

Aniseikonia can be caused by various factors, but (for) the fact that it can be induced by anisometropic correction and aphakic surgery, makes it more alarming. Hence to fully provide quality and comprehensive eye care services, Aniseikonia needs to be studied effectively, and management of this condition must be practiced in (the) a routine setting. Currently, there is little knowledge (on) of aniseikonia and its related practices in Kumasi. Even on (the) a global scale, there are limited studies, with most of the studies citing aniseikonia as a disorder with regards to anisometropia and binocular vision. Studies conducted by Levi et al. (2007) and Hess et al. (2014) sought to fill the gap in the knowledge of the prevalence of aniseikonia ,they concluded by stating that at least two-thirds of patients with amblyopia have anisometropia; thus, we may expect the true prevalence of aniseikonia in this population to be high.

There is still (the) a need to focus on regions excluded from these studies especially in developing countries to improve discussions and practice. This will help fill the gap in knowledge of aniseikonia in developing countries. At the core of the 2030 Agenda for Sustainable Development, are the seventeen Sustainable Development Goals. These goals acknowledge that putting an end to poverty and other deprivations must go alongside strategies that advance health and education, decrease inequality and speed up the growth of the economy. The third sustainable development goal is to ensure healthy lives and promote well-being for all at all ages (United Nations Department of Economic and Social Affairs, 2015). The ability of professionals in the eye care sector to detect, diagnose and manage patients with aniseikonia will contribute to achieving this goal. Therefore, this study was formed to determine the prevalence of aniseikonia among the people in Kumasi.

There is a lack of standardized management for aniseikonia in Ghana among eye care professionals in the healthcare space. Hence, (the)there is a need to investigate the prevalence of aniseikonia and its impact on the quality of vision in Ghana. As the prevalence of symptomatic aniseikonia rises as a result of more ocular surgeries and an aging population, eye care providers ought to be more interested in its management. There is scanty literature on the prevalence of aniseikonia in Africa, with Ghana being no exception. This study will provide information on the prevalence of aniseikonia in Kumasi.

MATERIALS AND METHODS (METHODOLOGY)

Study design and Setting

This was an analytical cross-sectional study in which individuals with anisometropia and pseudophakia were screened for aniseikonia. The study was conducted from June to September 2022 in the Kumasi Metropolis. The Kumasi Metropolis has a population of 3,630,000 as of 2022, according to United Nations world population prospects. It is situated in the central part of the Ashanti region of Ghana. The university is found about 31 kilometers to the east of Kumasi and the main university campus is about seven square miles in area.

Inclusion Criteria

People of all ages who had undergone cataract surgery and were student wearers of corrective spectacles were recruited for the study.

Sampling and Sample size

Purposive convenienc(t)e sampling was used to select the study participants. The sample size needed for the study was determined using the sample size formula

$$, n = \frac{p(100-p)z^2}{E^2}$$

Where n is the required sample size, p is the percentage occurrence of the condition, E is the percentage maximum error required and z is the value corresponding to the level of confidence required. The sample size calculated from this was 385, using a confidence level of 5%. This formula was chosen in order to make the results (generalizable) representative from of the sample and avoid sampling errors or biases (Gill *et al*., 2010).

An announcement was broadcast on chat groups and social media to instruct spectacle wearers to come to the testing location, which was the College of Science Optometry Eye Clinic. The data on the post cataract surgery patients (were) was obtained from folders of patients (of) at the hospital.

Ethical Considerations

The participating school was visited at least two weeks before the screening day, and permission to conduct the study was sought from the headmaster or headmistress. Participant information leaflets (was) were attached to the parental informed consent form and given to each of the students to be taken to their parents or guardians. Only students and pseudophakes who returned duly signed consent forms, and were willing to take part in the exercise were recruited. (Parents who required further explanation before consenting for their children to participate in the study were invited to the particular school of the ward on the screening day, for further education).

Ethical approval was obtained from the Committee on Human Research, Publication and Ethics, (CHRPE), School of Medical Sciences, Kwame Nkrumah University of Science and Technology in Kumasi, Ghana.

Aniseikonia Screening

The research was conducted using a quantitative approach. The procedure was explained to the participants and then they were asked to sign consent forms. The participants first had their demographic data recorded, then, their spectacles were examined to record their prescriptions using a well calibrated focimeter. After that, they were examined using the new aniseikonia test (Awaya) and the red and green anaglyph glasses to determine whether aniseikonia was present and measure(d) the amount if detected. The Aniseikonia Inspector software 3.0 was used to calculate the amount of aniseikonia based on the difference in refractive powers in the eyes. The whole process was noninvasive and did not cause any harm to the participant or put them at any risk. The data on the post cataract surgery patients (pseudophakes) were obtained from the hospital and entered into the Microsoft Excel Spreadsheet 2016 and then the amount and magnitude of the aniseikonia (was)were measured using the Aniseikonia Inspector 3.0 software.

Definitions

Aniseikonia is defined as a perceived size difference of more than 3% between the two eyes. Aniseikonia generally becomes symptomatic at a 3–5 percent magnification

difference between the two eyes, although individuals with lower percentages may also experience symptoms if they are sensitive. Anisometropia is defined as a difference of more than 1D (dioptre) between the spherical equivalent prescriptions of the two eyes with a threshold of 3D (dioptres). Isometropia is defined as the condition in which both eyes have similar refractive power.

Statistical Analysis

Data were subsequently exported to the Statistical Package for Social Sciences (SPSS) version 26.0 software program for analysis. Analysis included the calculation of frequencies, distributions of demographic data and responses. Descriptive statistics was used to ascertain the frequencies and proportions of the socio-demographic variables (including the sex, age among others) of the individuals who participated in the study.

RESULTS

Socio-demographic characteristics of participants

A total of 178 participants were enrolled in(to) the study. The majority of the participants were female (59.6%). Age range between 18-26 year(s) (66.9%) were enrolled (from) in tertiary institutions (70.2%). The 18-26 year(s) category had the highest number of participants, 119 (66.9%), followed by the 13-17 year(s) group, 43 (24.2%), while the 27 and above year groups had the least number of participants, 16 (9.0%). The mean (±SD) age of all respondents was 22.6 (±12.02) years, with minimum and maximum ages of 13 and 79 years, respectively. Twenty-two cases of aniseikonia were identified. The highest percentage of aniseikonia was recorded among the 18-26-year-old age group, as shown in (t)Table 1.

Table 1: Socio-Demographic Characteristics of Participants

Variable		n (%)
Sex		
	Male	72 (40.4)
	Female	106 (59.6)
Age in Years		
	13-17	43 (24.2)
	18-26	119 (66.9)
	27 and above	16 (9.0)
Students		
	Junior High School	
	Basic 7	14 (7.9)
	Basic 8	11 (6.18)
	Basic 9	18 (10.1)
	Senior High School	0
Tertiary		125 (70.2)
	Level 100	12 (6.7)
	Level 200	24 (13.5)
	Level 300	31 (17.4)
	Level 400	34 (19.1)
	Level 500	14 (7.9)
	Level 600	6 (3.4)
	Post-Graduate	4 (2.2)
Pseudophakes		9 (5.1)

n; number of participants, %; percentage of participants

The prevalence of aniseikonia in the Kumasi Metropolis in 2022 saw a total sample population of 178 from a study population of spectacle wearers, of which 22 (12.4%) were anisometropic.

Females with aniseikonia and males with aniseikonia recorded 11 each, representing 50%, as shown in (t)Table 2. In terms of age, the 13(to)–17-year(s)-old group had the highest figure of 10 (45.5%). The 28(years) and above age group followed closely with 7 (31.8%), and the 23- to 27-year-old age group was the least of the cases, registering 2 (9.1%). The (p)Prevalence of aniseikonia has the following figures; of the total of 22, 14 (63.6%) aniseikonia cases were anisometropic corrected, and 8 (36.4%) were isometropic corrected. (t)Table 2.

Table 2: Demographic distribution of aniseikonia among Selected Spectacles Wearers in Kumasi

Variable		n (%)
Aniseikonia		
	Isometropic correction	8 (36.4)
	Anisometropic correction	14 (63.6)
Age Group		
	13 to 17	10 (45.5)
	18 to 22	3 (13.6)
	23 to 27	2 (9.1)
	28 and above	7 (31.8)
Sex		
	Male	11(50.0)
	Female	11(50.0)

n; number of participants, %; percentage of participants

Of all the 22 cases of aniseikonia, an associated symptom(s) with eyestrain recorded the highest value of 6.2%, followed by dizziness with 2.8%. Nausea recorded (the) a minimum value of 0.6%, as shown in (t)Table 3.

Table 3: Symptoms associated with aniseikonia among participants

Symptoms		Aniseikonia n(%)	No Aniseikonia n	(%) P-value
Headaches				
	Yes	4 (2.2)	132 (74.2)	0.305
	No	18 (10.1)	24 (13.5)	
Eyestrain				
	Yes	11(6.2)	134 (75.3)	0.732
	No	11(6.2)	22 (12.4)	
Dizziness				
	Yes	5(2.8)	2(1.1)	0.813
	No	154 (86.5)	154 (86.5)	
Nausea				
	Yes	1 (0.6)	0 (0.0)	0.953
	No	156 (87.6	156 (87.6)	

P<0.05 significant, n; number of participants

The prevalence of anisometropia was 14 (7.9%), with 8 (4.5%) females and 6 (3.4%) males, respectively. The 13–17-year-old age group recorded the highest number of 5 (2.8) of the total number of participants (178), while the 18–22-year-old age group showed the least number of only 1 (0.6%) Table 4.

Table 4: Prevalence of anisometropia within sex and age group.

Variable		n (%)
Anisometropia		
	Male	6 (3.4)
	Female	8 (4.5)
Age Group		
	13 to 17	5 (2.8)
	18 to 22	1 (0.6)
	23 to 27	**4 (2.2)**
28 and above		4 (2.2)

DISCUSSION

The study presents new data on the prevalence of aniseikonia in the Kumasi Metropolis, and further, explored the association between clinically significant aniseikonia and anisometropia. In brief, the point prevalence of aniseikonia was 12.5%, with equal proportions of females and males. The results from similar studies found the prevalence of measurable aniseikonia in a cohort was 7.8%, with moderate amounts of induced aniseikonia at 4% (Bruce, 2019).

Thus, probably uninduced with 3–5% aniseikonia, our results were slightly higher compared with this study. The high prevalence of aniseikonia was attributed to the high numbers of anisometropia in the study. There was no significant relationship between the prevalence of aniseikonia and gender in the study.

The observed disparity in prevalence rates could be attributed to differences in the characteristics of the study populations, such as age group, sampling method, methodology, and eligibility criteria. The differences could also be (as) a result of the differences in study design and measuring tools. The current study showed that 12.9% of the participants had anisometropia. Other studies reported a lower prevalence of 5.6% to 9.2% (Ostadimoghaddam *et al*., 2012; Mohammadi *et al*., 2013; Nunes *et al*., 2021). Comparing the results of aniseikonia in anisometropic and non-anisometropic patients, no statistically significant differences were found.

Out of the number of subjects who had aniseikonia of 3% or more (clinically significant aniseikonia), 59.0%, 50%, 22.7%, and 4.5% reported symptoms of headache, eyestrain, dizziness, and nausea, respectively. According to a ten-year clinical study, 67% of aniseikonia patients experience headaches and eyestrain, 15% experience nausea, and 7% experience dizziness (Bannon and Triller, 1944), which corroborates our findings.

10.3% of isometropic participants had aniseikonia compared to 28.6% of anisometropic participants who had aniseikonia; therefore, the prevalence of aniseikonia among participants with anisometropia was more than twice that of those who did not have anisometropia.

The study found that there was a significant relationship between anisometropia and aniseikonia ($p = 0.18$). Among the participants who had undergone cataract surgery, it was found that more than half of them had aniseikonia, which correlates with an earlier study (which) that found subjective complaints attributed to aniseikonia in 40.2% of pseudophakia patients (Kramer *et al*., 1999). After cataract surgery and anisometropic correction, 6% to 12% of anisometropic and pseudophakia patients may experience some aniseikonia, which, if untreated, can result in amblyopia. These patients must be managed by optometrists and ophthalmologists in the clinic setting.

Limitations of the Study

There was an inadequate number of participants who had undergone cataract surgery. This was because there was insufficient time and (limited) a lack of financial and human resources.

CONCLUSION AND RECOMMENDATION

The prevalence of aniseikonia in the study is significant (12.5%) and prevalent in people with corrected anisometropia and pseudophakia. Aniseikonia tests should be performed in the clinic setting when symptoms of asthenopia persist even after the dispensing of the correct refractive prescription.

Aniseikonia is likely to be present in many patients with anisometropia, as both corrected and uncorrected anisometropia can both cause aniseikonia.

It is clear that wearing iseikonic lenses relieves distressing symptoms (in) for a considerable number of individuals who are unable to find comfort in any other way. This is evident of the practical value of aniseikonia, therefore, optometrists and other eye-care professionals should evaluate a patient for aniseikonia when other causes of asthenopia and fusion problems have been ruled out. Cataracts among (aged) elderly people (is) are on the rise, and with it, an increase in the number of patients who undergo cataract surgery. This might inadvertently lead to an increase in the number of patients in need of aniseikonia service.

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