

## Physical Defects, Maintenance and Handling of Ophthalmic Lenses by Students of Kwame Nkrumah University of Science and Technology

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### Abstract

**Introduction:** Optical glasses to aid vision are the means for correcting eyesight defects when owned as complete glasses, or when adapted to the ultimate wearer or consumer. A vast majority of people go for corrective lenses to correct their refractive errors and consequently have improved vision. The study was conducted among students at Kwame Nkrumah University of Science and Technology who wear spectacles to determine the physical defects of the spectacles, the level of maintenance and handling of ophthalmic lenses exhibited them.

**Materials and Methodology:** A descriptive cross-sectional study was carried out in Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. A simple random sampling strategy was used to select a specified number of students wearing ophthalmic lenses from the six colleges for this study. Thus, 300 students from KNUST were involved in the study.

**Results:** Three hundred (300) students were involved in the study. Of the 300 students, 202 (67.3%) were males and 98 (32.7%) were females. College of Engineering recorded the highest number of males and Colleges of Science and Arts and Social Sciences had majority females. Out of the 98 female students, 18 (18.4%) had a visual effect (asthenopia, diplopia or blurred vision). Similarly, 50 male students out of the 202 had a visual effect. This shows a percentage of 24.7%. Majority (179) students had bent temples, 119 had scratches on their spectacles and students with cracks on their spectacles recorded the least (17). A total of 123 students from all the Colleges used handkerchief to clean their spectacles and lens surfaces. Forty-eight (48) students used tissue, 58 used lens cleaner and 60 students used cotton wool to clean their spectacles. Hundred and eighty-three students keep their spectacles in their cases. A few kept their spectacles anywhere and also in their pockets.

**Conclusion:** The prevalence of the rate of use of dry cloth by students in this study to clean their spectacles shows a deviation from the use of the right spectacle cleaning material (warm soapy water and towel). It can be deduced that a lot of students exhibit poor maintenance habits. Most students do not take good care of their ophthalmic corrective lenses.

**Keywords:** Asthenopia; Corrective lens; Diplopia; Maintenance; Refractive error; Spectacles

## Introduction

A corrective lens is an ophthalmic lens which corrects the error of refraction or other optically correctable deficiencies of the eye or eyes (Sasian-Alvarado, 1992). An optical defect is any physical or mechanical defect of an optical system that prevents the clear formation of an image, as found in ametropic conditions of the eye or aberrations of the optical system (lens and cornea) (Gauss and Bessel, 1880). A lens is a piece of glass or other transparent substance having two opposite regular surfaces, either planed or curved functioning as part of all of an optical system (Cline., *et al.* 1997). Optical glasses to aid vision are the means for correcting eyesight defects when owned as complete glasses, or when adapted to the ultimate wearer or consumer. The component parts, i.e. lenses and supporting materials, are produced or reproduced to individual specific formulas (Frerichs, 1953).

A vast majority of people go for corrective lenses to correct their refractive errors and consequently have improved vision (Karnani, *et al.* 2010). However, most of these people later begin to have problems with their vision using the spectacles for which they cannot account. Their hope of having a clearer vision is dashed and they begin to throw their hands in despair. The lens they bought with their hard earned currency becomes a white elephant. This makes them discontinue its use. This study will therefore bring to light how handling of one's spectacle can cost one's comfort and improved vision. Corrective lens users in this part of Africa do not realize the little faults that occur to their lenses. These faults, though insignificant, often result in one's discomfort, affecting cosmetic outlook and visual perception of the individual and reducing the durability of the lenses.

Physical defects on lenses are as a result of incorrect handling and influx of poor quality lenses due to mass production. As a result of the effects mentioned above, much work is being done at the manufacturing level to reduce these defects. Global estimates indicates that approximately a quarter of the world's ophthalmic spectacle wearing population (350,000,000–500,000,000 people) mishandle their spectacle prescription. This however induces some amount of phoria (separation of retina images) (Tait, 1950).

Studies have shown that with increasing age, people become more careful and so the prevalence rates of spectacle defects follow a basic pattern with wearers between the ages of six and seventeen bearing the risk 'tag' (Jalie, 2003). Therefore the study was conducted among students at Kwame Nkrumah University of Science and Technology who wear spectacles to determine the physical defects of the spectacles, the level of maintenance and handling of ophthalmic lenses exhibited them.

## Materials and Methodology

A descriptive cross-sectional study was carried out in Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. A simple random sampling strategy was used to select a specified number of students wearing ophthalmic lenses from the six colleges for this study. Thus, 300 students from KNUST were involved in the study. Respondents were interviewed using a questionnaire. The questionnaire was used to obtain socio-demographic information as well as the level of handling and maintenance of ophthalmic lenses and their physical defects. The study was approved by the Department of Optometry and Visual Science, Kwame Nkrumah University of Science and Technology. The nature and purpose of the study was explained to the participants and consent obtained. No probable risks were anticipated for those who chose to participate in the study. The information gathered was treated with confidentiality and was not shared with any third party who was not directly involved in the study. The study was also carried out in adherence to the tenets of Declaration of Helsinki. Using descriptive statistics, data collected were input into Excel and analyzed using IBM SPSS Statistics version 23 (IBM Corp., Armonk, New York, USA). Descriptive statistics were employed and Chi-squared test ( $\chi^2$ ) was used to compare the variables and p-values less than 0.05 at confidence interval of 95% were considered significant.

## Results

Three hundred (300) students were involved in the study. Of the 300 students, 202 (67.3%) were males and 98 (32.7%) were females. College of Engineering recorded the highest number of males and Colleges of Science and Arts and Social Sciences had majority females. Table 1 shows the representation of students by the Colleges.

College	Male [N (%)]	Female [N (%)]
Arts & Social Sciences	30 (10.0)	20 (6.7)
Engineering	42 (14.0)	8 (2.7)
Health	32 (10.7)	18 (6.0)
Planning & Architecture	34 (11.3)	16 (5.3)
Science	30 (10.0)	20 (6.7)
Agriculture & Natural Resources	34 (11.3)	16 (5.3)
Total	202 (67.3)	98 (32.7)

Table 1: Distribution of participants by College.

Out of the 98 female students, 18 (18.4%) had a visual effect (asthenopia, diplopia or blurred vision). Similarly, 50 male students out of the 202 had a visual effect. This shows a percentage of 24.7%.

College	Males [N (%)]	Females [N (%)]
Arts & Social Sciences	9 (13.2)	2 (2.9)
Engineering	12 (17.6)	5 (7.4)
Health	5 (7.4)	3 (4.4)
Planning & Architecture	9 (13.2)	4 (5.9)
Science	9 (13.2)	2 (2.9)
Agriculture & Natural Resources	6 (8.8)	2 (2.9)
Total	50 (73.5)	18 (26.5)

Table 2: Proportion of visual effects by gender and colleges.

The physical defects found with the spectacles of the students are open frame, scratches, bent temples, absence of nose pad and cracks. Majority (179) students had bent temples, 119 had scratches on their spectacles and students with cracks on their spectacles recorded the least (17). Details are shown in figure 1.

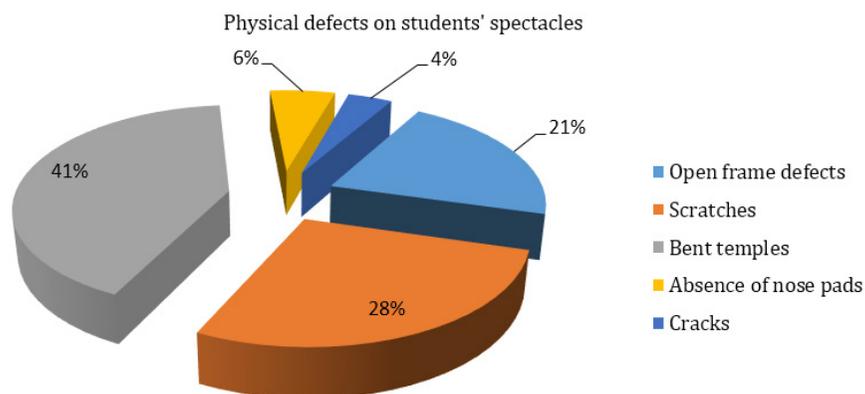


Figure 1: Types of physical defects on students' spectacles.

The College of Health Sciences registered the highest frequency in terms of open frame defects while the Planning and Architecture had the least number (10). Ninety-one students had open frame defects. Table 4 shows details of the various physical defects on the students' spectacles by their Colleges.

College	Open frame defects	Scratches	Bent temples	Absence of nose pads	Cracks on the spectacles and lens surfaces
Arts & Social Science	19	21	31	4	6
Engineering	15	18	32	2	2
Health	13	25	25	7	2
Planning & Architecture	10	30	33	8	1
Science	16	15	20	1	2
Agriculture & Natural Resources	18	10	38	3	4
Total	91	119	179	25	17

**Table 3:** Distribution of physical defects of spectacles by the Colleges.

In terms of maintenance and handling of ophthalmic lenses, the study investigated the type of materials used for cleaning the spectacles and lens surfaces. A total of 123 students from all the Colleges used handkerchief to clean their spectacles and lens surfaces. Forty-eight (48) students used tissue, 58 used lens cleaner and 60 students used cotton wool to clean their spectacles. Further details are depicted in Table 3 below.

College	Materials for cleaning spectacles					
	Handkerchief [N (%)]	Tissue [N (%)]	Lens cleaner [N (%)]	Dry cloth [N (%)]	Cotton wool [N (%)]	Warm soapy water & towel [N (%)]
Arts & Social Science	22 (7.3)	11 (3.7)	8 (2.7)	9 (3.0)	0 (0.0)	0 (0.0)
Engineering	23 (7.7)	9 (3.0)	6 (2.0)	9 (3.0)	2 (0.7)	0 (0.0)
Health	17 (5.7)	7 (2.3)	14 (4.7)	11 (3.7)	0 (0.0)	1 (0.3)
Planning & Architecture	20 (6.7)	6 (2.0)	10 (3.3)	11 (3.7)	3 (1.0)	0 (0.0)
Science	19 (6.3)	7 (2.3)	11(3.7)	10 (3.3)	1 (0.3)	1 (0.3)
Agriculture & Natural Resources	22 (7.3)	8 (2.7)	9 (3.0)	10 (3.3)	1 (0.3)	2 (0.7)
Total	123 (41.0)	48 (16.0)	58 (19.4)	60 (20.0)	7 (2.3)	4 (1.3)

**Table 4:** Means of cleaning ophthalmic lenses.

Regarding to keeping of the spectacles, the students gave various ways they kept them. They were kept in cases, on tables, in bags, under pillow, in the pocket and others said anywhere. Hundred and eighty-three students keep their spectacles in their cases. A few kept their spectacles anywhere and also in their pockets. Figure 2 shows details.

The students who had physical defects on their spectacles had at least one visual effect. It was found that 27 students with open frame defects had at least a visual effect. Thirty-four students with scratches, 41 students who had bent temple defect and 25 students who had their nose pad(s) absent had at least a visual effect. Five students with cracks on their spectacles had a visual effect. Details are depicted in Figure 3.

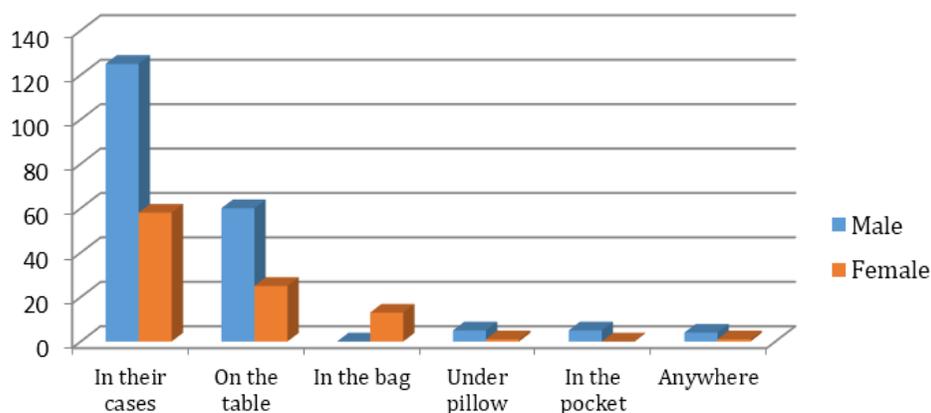


Figure 2: Means of storing or keeping spectacles by students.

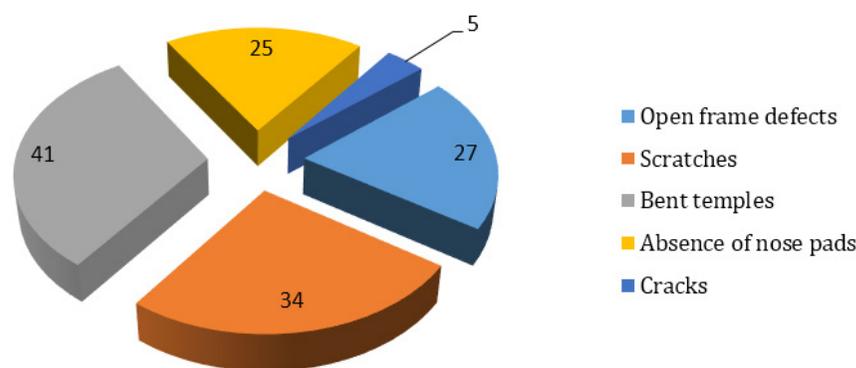


Figure 3: Distribution of physical defects in terms of visual defect.

### Discussion

The results show a male preponderance among the study population as 202 (67.3%) of the respondents were males while 98 (32.7%) were females. Quite a number of the students had an effect (either asthenopic symptoms, diplopia or blurred vision) as a result of the poor maintenance and handling of the spectacles. These effects are most likely to be linked to the ways the students stored or kept their spectacles and the materials used to clean the lens surfaces.

In the study, 179 (41%) students had bent temples. One can detect this defect when the spectacle is placed on a flat surface. It is seen that one temple is higher than the other. Bent temples are mostly associated with students using one hand have bent temples. This is commonest defect identified with students who use spectacles. Bent temple defect is the most difficult to determine by the wearers and could pose threats to one’s vision. The irregularity between the temples affects the alignments of the lenses. This can bring about decentration of the lens, which leads to deviation of images (prismatic effect). In figure 3, 41 students with bent temples have at least one visual effect. This implies that bent temples have more damaging visual effect than any of the other physical defects.

Prevalence of scratches was 28% (119 students out of 300). A scratch is any mark on the lens surface which makes it rough. Scratches can be found at any part of the lens either at the central portion or at the periphery. Light entering the eye passes through the central part of the lens and then through the pupils before reaching the retina. Scratches located centrally can distort the path of light. This can affect vision and hence the visual acuity. Presence of a lot of scratches on the lens surface can give the lens a poor cosmetic outlook. In figure 3, 34 students have at least one visual effect (Asthenopia, Diplopia and/or blurring) as a result of the scratches. Scratches are irreversible at the consumer level.

In the total population, 91 students had open frame defect as a result of using one hand in putting on or taking off their spectacles. Open frame is when the spectacle frame is bent from the nose bridge either inward or outward. This affects the cosmetic outlook and the comfort of the wearer. About half of those who stated that they use both hands may not be doing so consistently. Using one hand to put on/take off the spectacles puts pressure on the nose bridge causing it to bend inwards or outwards. At other times certain students may deliberately bend the nose bridge so the spectacle could fit their nasal slope. This affects the alignment of the spectacle; if it opens outwards, it creates a distance between the face and the nose bridge making the spectacle drop easily. The drop may cause a change in the focal power of the lens thereby affecting vision. If the bend is inward, the spectacle may cling too much to the face causing irritation.

Nose pads are attached to the lower nasal sides of the rim. They allow the spectacles to sit comfortably on the nose and to be well suspended on the face. Their principal function is for comfort and so their absence causes discomfort and irritation. It may also cause the spectacle to drop below the expected level. As people use the spectacle without nose pads, the metal to which it is attached to the rim brushes the face continuously. Some people develop black spots as a result of this. In Table 3 only 25 students were found to have no nose pads, while in fig 3, nose pad absence indicates only 15 students having at least one of the visual effects. This represents 60.0% of those without the nose pad. It shows that though the number of students without nose pad is not much, it should be of much concern to the wearers. The low prevalence of absence of nose pads can be attributed to the fact that because it causes irritation, the wearers do not wear it often or discard it to get a new one.

Only 4% of the total number with physical defects on the spectacles had cracked lenses. Cracks are breakages in the lens. In this study, the types of cracks found were minimal. Cracks are conspicuous and many students will not entertain them. This may account for its rare occurrence. In figure 2, 183 (61.0%) of the students indicated they kept their spectacles in their cases while 85 (28.3%) students kept their spectacles on tables when not in use. More often than not students place their spectacles with the front lens surface downwards. This causes scratches on the lens surface. Though most students claim they keep their spectacles in a case when not in use, it may not always be so. They may intermittently leave it on tables or other flat and usually hard surfaces. This accounts for the high occurrence of scratches recorded in this study. The frequent occurrences of scratches on spectacles have influenced the introduction of scratch resistant coatings by ophthalmic lens manufactures.

Regarding the ways by which the students cleaned their spectacle lens surfaces, most of them used handkerchiefs. Handkerchiefs are mostly made of cotton material and purposely for wiping seat. This makes it dirty and greasy. In our setting, most spectacle wearers do not have a spare handkerchief purposely for their lenses. They therefore use the same for the face and for the spectacle. Grease from the handkerchief is then transferred to the lens thus defeating the purpose of cleaning. The grease on the lens surface rather attracts dust thereby causing blurred vision.

Out of the 300 students, 123 representing 41.0% used handkerchief to clean their spectacles. This could result in a high frequency of blurring effect. Fifty-eight people, representing 19.3% use lens cleaner to clean their spectacles. This shows a great deviation from the use of the recommended material. The spectacle case comes with the lens cleaner. This implies that the lens cleaner is a recommended material to be used for cleaning spectacles. The low rate of using lens cleaners to clean spectacle lens surfaces could be linked to the facts that majority of students have misplaced their lens cleaners or do not know its use. The use of dry cloth to clean spectacles is the second most common. Dry cloth may be any material; shirt, towel, etc. The texture of any material is very significant in this case. Rough textures could cause scratches on the lens surface. The use of dry clothes and handkerchiefs could account for the high prevalence of scratches in the study. The effects associated with the physical defects of the spectacles could also be attributed to the materials used to clean the surfaces. Cotton wool although would not cause any damage to the lens, it will not perfectly clean it and blurring may occur to some extent.

Only 5 (1.3%) students used warm soapy water and towel to clean their spectacles. Warm soapy water removes grease and all kinds of dirt completely from the lens. This is the best way to clean one's lens. The other 98.7% of the population who do not use warm soapy water and towel show a high rate of improper handling of spectacles in terms of cleaning. Health care professionals in the eye sector could attribute this to the lack of education for students in terms of handling and cleaning of their spectacles. The effects associated with the physical defects may compel people to change their spectacles frequently or they may not be enjoying improved vision for which the glasses were meant to.

## Conclusion

The prevalence of the rate of use of dry cloth by students in this study to clean their spectacles shows a deviation from the use of the right spectacle cleaning material (warm soapy water and towel). Twenty-eight percent (28.0%) of students have scratches on their spectacles as a result of improper positioning of their spectacles. Only 39.0% of the students were to keep their spectacles in its case and the other 61.0% of those who said they keep it in its case to not keep it the case all the time. It can be deduced that a lot of students exhibit poor maintenance habits. In the study, 93.3 do not use the recommended material to clean the lens. Thirty-nine percent of students do not keep their spectacles at the right place. It was found that all the 300 students selected at random had at least one physical defect. It can be concluded that most students (98.3%) do not take good care of their ophthalmic corrective lenses.

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