Original Article

Ocular Health and Safety Assessment among Mechanics of the Cape Coast Metropolis, Ghana

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Abstract

Purpose: To conduct an ocular health and safety assessment among mechanics in the Cape Coast Metropolis, Ghana.

Methods: This descriptive cross sectional study included 500 mechanics using multistage sampling. All participants filled a structured questionnaire on demographic data, occupational history and ocular health history. Study participants underwent determination of visual acuity (VA) using LogMAR chart, external eye examination with a handheld slit lamp biomicroscope, dilated fundus examination, applanation tonometry and refraction.

Results: Out of 500 mechanics, 433 were examined (response rate, 87%) comprised of 408 (94.2%) male and 25 (5.8%) female subjects. The prevalence of visual impairment (i.e. presenting VA < 6/18) among the respondents was 2.1%. Eye injuries were reported in 171 (39.5%) mechanics probably due to the large number of workers, 314 (72.5%), who did not use eye protective devices. Mechanics in the auto welding category were at the highest risk of sustaining an eye injury (odds ratio [OR], 13.4; $P < 0.001$). Anterior segment ocular disorders were mostly pterygia while posterior segment eye disorders included glaucoma suspects and retinochoroidal lesions. The development of pterygia was associated with the number of years a mechanic stayed on the job. Eye care seeking behavior among the participants was poor.

Conclusion: Eye injuries were prevalent among the mechanics as the use of eye protection was low. Eye safety should be made an integral part of the public health agenda in the Cape Coast Metropolis.

Keywords: Cape Coast; LogMAR; Mechanics; Ocular Health; Pterygium; Visual Acuity

J Ophthalmic Vis Res 2016; 11 (1): 78-83.

INTRODUCTION

Occupational eye injuries are known to cause severe morbidity and immense economic loss,[1,2] with nearly half a million people worldwide having monocular blindness as a result of ocular injuries.[3] Unfortunately, workers in developing countries disproportionately suffer the burden of these occupational health problems.[4] It is estimated that in developing countries, the adult working population is highly exposed to workplace related hazards[5] and that up to 5% of all blindness in such countries may be due to work related injuries.[6] A combination of factors such as poor working conditions, longer hours at work and inadequate or poor safety precautions can lead to increased rates of ocular trauma and diseases in developing countries.[7] Mechanics, particularly welders are at high risk for eye injuries as they are exposed to a number of sources of energy.[8] Some of the hazards in the job settings of these workers include dust, sun radiations, metal part crusting, and chemicals. Injuries and other disorders

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Received: 27-12-2014 Accepted: 12-02-2015

Access this article online

Quick Response Code:

Website: www.jovr.org

DOI: 10.4103/2008-322X.158890

resulting from these hazards may lead to reduced vision and ultimately blindness. However, most of the eye disorders which mechanics suffer in the course of work can be prevented using proper eye protection such as safety goggles, face shields and helmets.[9,10] Indeed, Alvi et al concluded that industrial ocular injuries are mainly preventable if strict compliance on the use of well-fitted and visible protective eyewear is adhered to.[2] The use of appropriate eye protection has been reported to prevent approximately 90% of eye injuries.[11] Compliance with strict regulations regarding occupational health and safety has led to a decline in work related accidents in most industrialized economies.[4,12] These regulations are mostly absent in developing economies.[11] Mechanics in Ghana constitute 11.5% of the human resource sector,[13] hence ocular morbidity among them could be detrimental to the national economy. The prevalence and pattern of eye disorders and injuries among mechanics in Ghana have not been documented. Furthermore, the absence of any occupational health policies which pursues the ocular health of these workers hinders interventional planning.[13,14] This study was conducted to determine the ocular health and safety status among mechanics of the Cape Coast Metropolis in the central region of Ghana.

METHODS

Study Area

This study was conducted in the Cape Coast Metropolis of the Central region of Ghana. The Central Region of Ghana occupies an area of 9,826 km^2, which is approximately 6.6% of the total land of Ghana. The region consists of 20 administrative districts and has an estimated population of 2,201,863 with an annual growth rate of 3.1%. The Cape Coast Metropolis covers an area of 122 km^2 with an estimated population of 169,894 including 82,810 (48.74%) males and 87,084 (51.26%) female subjects. The population of artisans in the metropolis was about 1,200 of whom 550 were mechanics. The village is made up of numerous workshops belonging to auto mechanics, auto electricians, auto welders, sprayers, key cutters, blacksmiths and spare parts dealers.

Study Design and Sample Selection

This cross-sectional study was conducted on mechanics between January and May 2014. Using the expression $n = z^2 (1 - p) (p)/d^2$, (n = minimum sample size, P = anticipated prevalence [assumed to be 50%], d = desired error bound taken as 5% and z = the standard score at 95% [1.96]), a minimum sample size of 384 was calculated. Adjusting for 10% attrition rate, a minimum of 425 mechanics were desired. A list of major mechanic parks as well as their locations at the artisan villages was obtained from the executives of the Mechanic Association in Cape Coast. Following this, a list of registered mechanics including auto welding, auto mechanic, auto electrical, air conditioning operation and battery system operation was obtained. Using a multistage sampling approach, 433 mechanics were selected. The population of mechanics was divided into groups or clusters based on the category of mechanic work involved. A number of shops within each cluster were then chosen at random and mechanics within the chosen workshops were selected. Mechanics were randomly selected proportionate to the size of the park to constitute the study population. We included "others" who were involved in minor mechanic works but were not categorized as above.

Study Procedure

A pretested questionnaire designed based on previous studies was used to collect vital information from the participants. The questionnaire was interviewer administered and sought information on demographic data, occupational history and ocular safety measures adopted by the mechanics. All participants had their eyes examined for ocular abnormalities. The procedures included assessment of visual acuity (VA) using the LogMAR chart at 4 meters for distance and 40 cm for near. Anterior segment examination was conducted using a portable handheld slit lamp biomicroscope while internal ocular examination was performed after dilating the pupils with 0.5% tropicamide drops and observing the retina with a monocular hand held ophthalmoscope. Perkins applanation tonometry was performed in persons suspected of glaucoma after instillation of proparacaine hydrochloride and fluorescein dye. All respondents who read better than the 0.0 line on the LogMAR letter chart had their VA assessed again with a + 1.00 Diopter (D) lens. The aim was to determine latent hyperopia. Both subjective and objective refraction were performed on all participants whose VA was worse than 0.2 and those who read better than 0.2 with the + 1.00D. Objective refraction was performed using a retinoscope in a dark room. Visual impairment (VI) was classified based on the International Classification of Diseases criteria.[15]

Myopia was defined as sphere power ≤ -0.50D; hyperopia was defined as sphere power $\geq +1.00$D; astigmatism was defined as cylinder power ≥ 0.75D; presbyopia was based on functional disability from near work and confirmation upon near vision assessment. A glaucoma suspect in this study was defined as vertical optic cup to disc ratio >0.4 and asymmetry of ≥ 0.2 with intraocular pressure >21 mmHg.[16]

Data Analysis

Data was analyzed using SPSS (SPSS Software Statistics for Windows, Version 21.0. Armonk, NY, USA: IBM

Corp). Chi square test was used to test associations between variables. A two-tailed $P \leq 0.05$ was considered as statistically significant. In addition, the descriptive data were analyzed in terms of frequencies and percentages.

Ethical Consideration

Ethical approval for the study was obtained from the Ethics Review Committee of the University of Cape Coast and the research was done according to the Helsinki Declaration on Research Regarding Human Subjects. A detailed rationale for the study was explained to respondents and individuals who agreed to participate signed a consent form. Confidentiality was ensured, and a forum was organized to educate participants on basic safety measures regarding their workplace. Those with ocular disorders were treated, and some referred for further attention.

RESULTS

Demographic Characteristics

Out of 500 mechanics enumerated, 433 were examined, equivalent to a response rate of 87%, including 408 (94.2%) male and 25 (5.8%) female cases. Mean age was 35.54±11.25 (range, 15 - 70) years. The respondents were made up of 123 (28.4%) auto welders, 114 (26.3%) auto mechanics, 81 (18.7%) auto electricians, 41 (9.5%) auto air-conditioning repairers and 29 (6.7%) battery system operators while 45 (10.4%) belonged to the "other" category (those involved in minor mechanic work). The majority of subjects, 142 (32.8%), had been on the job between 1 and 5 years, 95 (21.9%) had worked between 6 and 10 years, and 84 (19.4%) had worked over 20 years. The majority of the participants, 289 (66.7%), were Junior High School leavers while 13 (3%) had tertiary education.

Reported Ocular Discomforts

Itching was the most reported ocular discomfort experienced by 150 respondents [Table 1]. The association between ocular discomforts and the category of mechanics was not statistically significant (P = 0.13, confidence interval [CI]: 0.121-0.134). Table 2 shows the distribution of ocular discomforts experienced by the mechanics according to the number of years spent on the job. The association between the two variables was not statistically significant (P = 0.16, CI: 0.156-0.171).

Exposure to Ocular Hazards

A total of 408 participants reported to be exposed to various kinds of ocular hazards in a total multiple response of 736 (some gave multiple responses). These were mainly dust particles 259 (35.2%), engine oil 127 (17.3%), fire spark 117 (15.9%), metal crusting 104 (14.1%), battery acid 79 (10.7%) and other hazards 50 (6.8%). Auto welders had the highest total responses (236, 32.1%) of being exposed to ocular hazards while battery system operators had the least total responses (41, 5.6%) [Table 3].

Visual Impairment

With reference to presenting VA in the better-seeing eye, the prevalence of VI (VA < 6/18) in participants

Table 1. Reported ocular discomforts versus mechanic category of participants

Discomfort	Auto electrical	Auto welding	Air condition	Auto mechanic	Battery system operation	Others*	Total responses
No discomfort	23 (15.9)	37 (25.7)	19 (13.2)	45 (31.3)	7 (4.9)	13 (9.0)	144 (100)
Itching	31 (20.7)	39 (26.0)	12 (8.0)	38 (25.3)	11 (7.3)	19 (12.7)	150 (100)
Pain	6 (12.8)	15 (31.9)	2 (4.3)	12 (25.5)	5 (10.6)	7 (14.9)	47 (100)
Burning sensation	11 (15.7)	23 (32.9)	7 (10.0)	14 (20.0)	10 (14.3)	5 (7.1)	70 (100)
Photophobia	10 (26.3)	9 (23.7)	4 (10.5)	8 (21.0)	3 (8.0)	4 (10.5)	38 (100)
Tearing	17 (22.0)	25 (32.5)	7 (9.1)	15 (19.5)	3 (3.9)	10 (13.0)	77 (100)
F.B[b] sensation	14 (25.0)	22 (39.3)	2 (3.6)	11 (19.6)	5 (8.9)	2 (3.6)	56 (100)
Others	4 (18.2)	10 (45.5)	1 (4.5)	4 (18.2)	0 (0)	3 (13.6)	22 (100)
Total	116 (19.2)	180 (29.8)	54 (9.0)	147 (24.3)	44 (7.3)	63 (10.4)	604 (100)

CI, confidence interval; F.B[b], Foreign body. *Others, those involved in minor mechanic works. P=0.13, CI=0.121-0.134

Table 2. Ocular discomforts experienced versus number of years on the job

Experience ocular discomfort	Number of years on job					Total
	1-5	6-10	11-15	16-20	Over 20	
Yes	94 (32.5)	69 (23.9)	50 (17.3)	29 (10.0)	47 (16.3)	289 (100)
No	48 (33.3)	26 (18.1)	20 (13.9)	13 (9.0)	37 (25.7)	144 (100)
Total	142 (32.8)	95 (21.9)	70 (16.2)	42 (9.7)	84 (19.4)	433 (100)

P=0.16, CI=0.156-0.171

was 9 (2.1%). The majority of respondents, 424 (97.9%), had no impairment. Causes of VI were refractive errors in 5 (1.2%), cataracts in 3 (0.7%) and macular scars in 1 (0.2%) subjects.

Oculo-visual Disorders

Major oculo-visual disorders were refractive errors, and anterior or posterior segment eye disorders. A total of 29 (6.7%) respondents presented with refractive errors including astigmatism in 22 (75.9%), hyperopia in 5 (17.2%) and myopia in 2 (6.9%) subjects. Presbyopia was detected in 112 (25.9%) respondents.

Anterior Segment Ocular Disorders

Anterior segment ocular disorders (217 problems) were present were among 194 participants (some reported multiple cases) including 112 (51.6%) cases of pterygium; 28 (12.9%) cases of arcus senilis; 26 (12.0%) cases of cataract; 13 (6.0%) cases of corneal scars/ulcers; 9 (4.1%) cases of ptosis; 9 (4.1%) cases of allergic conjunctivitis; 7 (3.2%) cases of chalazia/stye; 3 (1.4%) cases of conjunctivitis, and other problems such as ectropion, entropion and blephritis accounting for 10 (4.6.2%). The majority of anterior segment ocular disorders, 57 (29.4%), occurred among auto welders [Table 4]. However, the association between anterior segment ocular disorders and mechanic category was statistically insignificant (P = 0.467). After adjusting for age, gender and the category of mechanic, the occurrence of pterygium was significantly associated with the duration of time a mechanic stayed on the job (1-5 years, 14.8%; 6-10 years, 18.9%, odds ratio [OR]=1.34, CI: 0.67-2.69, P = 0.4; 11-15 years, 27.1%, OR = 2.15, CI: 1.06-4.33, P = 0.03; 16-20 years, 38.1%, OR = 3.55, CI: 1.63-7.71, P = 0.001; >20 years, 45.2%, OR = 4.76, CI: 2.53-8.95, P < 0.001).

Posterior Segment Disorders

There were 75 posterior segment abnormalities which comprised of glaucoma suspects in 63 (84%) eyes; retinochoroidal lesions in 7 (9.3%) cases; hypertensive retinopathy in 2 (2.7%) subjects; vitreous haze in 1 (1.3%) eye; age-related macular degeneration in 1 (1.3%) eye and optic atrophy in 1 (1.3%) eye. The association between posterior segment abnormalities and categories of mechanics or duration on the job was not statistically significant (P > 0.05).

Awareness of Ocular Health and Safety Standards

The majority of participants, i.e. 388 persons (89.6%), responded "no" to having any knowledge on ocular health and safety standards and stated that they had not received any health and safety training/education before. The 45 respondents who reported to have some knowledge on ocular health and safety included 22 (48.9%) auto welders, 8 (17.8%) auto mechanics, 5 (11.1%) air conditioning mechanics, 2 (4.4%) battery system operators and 4 (8.9%) subjects in other jobs.

Ocular Injury and Use of Protective Devices

One hundred and seventy-one (39.5%) of the respondents reported to have sustained eye injury on the job with the majority of 77 (45.0%) being auto welders. The risk of a mechanic sustaining ocular injury was dependent on the category of mechanic work the individual participated. The highest risk mechanic category was auto welding (62.6%, OR = 13.4, CI: 4.93-36.36, P < 0.001), followed by auto electrical (39.5%, OR = 5.2, CI: 1.86-14.65, P = 0.002), then auto mechanic (34.2%, OR = 4.2, CI: 1.52-11.39, P =0.006); air condition repairers (29.3%, OR = 3.3, CI: 1.05-10.43, P =

Table 3. Mechanic category and reported ocular hazards exposed to

Hazards	Auto electrical	Auto welding	Air condition	Auto mechanic	Battery system operation	Others	Total responses
Dust particles	38 (14.7)	60 (23.2)	25 (9.6)	85 (32.8)	21 (8.1)	30 (11.6)	259 (100)
Engine oil	28 (22.0)	22 (17.3)	15 (11.8)	44 (34.6)	8 (6.3)	10 (8.0)	127 (100)
Battery acid	27 (34.2)	18 (22.8)	11 (13.9)	20 (25.3)	2 (2.5)	1 (1.3)	79 (100)
Fire spark	27 (23.1)	70 (59.8)	6 (5.1)	8 (6.8)	3 (2.6)	3 (2.6)	117 (100)
Metal crusting	22 (21.1)	50 (48.1)	9 (8.7)	17 (16.3)	3 (2.9)	3 (2.9)	104 (100)
Others	8 (16.0)	16 (32.0)	4 (8.0)	14 (28.0)	4 (8.0)	4 (8.0)	50 (6.8)
Total responses	150 (20.4)	236 (32.1)	70 (9.1)	191 (25.9)	41 (5.6)	51 (6.9)	736 (100)

Table 4. Distribution of anterior segment cases among the mechanic categories

Anterior segment cases	*n* (%)						
	Auto electrical	Auto welding	Auto air condition	Auto mechanic	Others	Battery system operation	Total
Yes	40 (20.6)	57 (29.4)	19 (9.8)	42 (21.6)	18 (9.3)	18 (9.3)	194 (100)
No	41 (17.2)	66 (27.6)	22 (9.2)	72 (30.1)	27 (11.3)	11 (4.6)	239 (100)

0.04); battery system operators (20.7%, OR = 2.1, CI: 0.5 7-7.60, *P* = 0.27) and finally the "others" (with minimal mechanic involvement, 11.1%).

Using eye protective devices during work was reported by 119 (27.5%) respondents of whom, 56 (42.2%) used goggles; 25 (20.2%) used hand held shield; 21 (16.9%) utilized face shield; 20 (16.1%) used Plano lenses and 2 (1.6%) used other forms of protective devices. Respondents who did not use eye protective devices during work gave reasons for not using them. A large proportion, i.e. 100 subjects (23.1%), said that the devices were not readily available, 80 (18.5%) said usage was not comfortable, 48 (11.1%) reported that they believed it was not needed, 33 (7.6%) said it was expensive, and 16 (3.7%) reported the device fogs with sweat during usage. No previous eye examination was reported by 257 (59.4%) mechanics while 176 (40.6%) responded in the affirmative.

Eye Health Seeking Behavior upon Sustaining an Eye Injury

Among the 171 (39.5%) participants who reported ever sustaining ocular injury on the job, 66 (39.3%) visited the hospital, 38 (22.6%) went to a pharmacy or chemical shop, 28 (16.7%) practiced self-treatment, 27 (16.1%) did nothing and 9 (5.4%) subjects used herbal medicine. Out of the 171 participants with the history of eye injury from the job, 79 (46.2%) had never undergone eye examination previously.

DISCUSSION

Safe and efficient visual functioning of mechanics is vital for efficient task performance.[17] The relatively low prevalence of VI in the present study (2.1%) is comparable to a similar study on industrial saw mill workers in Nigeria which recorded a prevalence of 4.3%.[18] A study among school pupils in the same city (Cape Coast, Ghana), however, found a prevalence of VI (VA < 6/18) to be 1.1%.[19] In the city of Tema, Ghana, VI was 3.7% among the general population aged at least 40 years. This rather higher VI rate was due to the high mean age (53 years).[20] Eye disorders diagnosed in this study were comparable to findings in Ghanaian farming and mining industries,[21,22] and in Kaduna,[23] Calabar,[24] and Warri,[25] in Nigeria where the incidence of pterygia, corneal opacities, cataracts, chronic conjunctivitis and glaucoma were observed. Similar to the current study, a high prevalence of pterygia was reported in a related study in India.[26] Boadi-Kusi et al, however, reported a lower prevalence of pterygium (2.7%) among Ghanaian farmers.[21] Pterygia are known to be prevalent in persons who spend considerable time outdoors.[27] Mechanics especially those involved in welding have shown to have significant high rates of pterygia due to their exposure to ultraviolet radiation, which is believed to be the most significant factor in pterygium development,[28] though chemicals and other irritants such as wind, dust, and smoke may contribute to pterygia.[29] This is particularly true for the present study in which a significant association between the occurrence of pterygia and the length of time a mechanic spent on the job was found. Glaucoma was suspected in 63 (15.2%) respondents, similar to a research conducted among industrial mine workers in Ghana through which glaucoma was found in 62 (15.3%) participants.[22] In the current study, 6% of the subjects showed cataracts, comparable to the study by Ovenseri-Ogbomo et al on industrial mine workers in which cataracts were found in 7.5% of the study participants.[22] However, it differs from the study conducted among cocoa farmers in a rural community in Ghana which reported a cataract prevalence of 20.0%.[21] The high difference in prevalence could be due to the older age of subjects in the previous study as cataracts are known to be age related.

The finding that the majority of the respondents, 314 (72.5%,) did not wear ocular protective devices during work is similar to a study conducted in South Eastern Nigeria,[30] and to the findings by Titiyal and Murthy in India where 96.4% of the workers studied did not use protective eye devices.[31] The reasons given for not using ocular protective devices were comparable to those in previous studies,[3,32] which included nonavailability, ignorance, and discomfort.

In the present study, mechanics in the auto welding category used more protective devices probably due to the fact that the majority of exposures to ocular hazards occurred in auto welders. The use of eye protective devices reduces the likelihood of getting injured during the job.[10] Titiyal and Murthy found that eye injury was not reported by respondents who used ocular protective devices.[31] Eye injury was reported by 171 (39.5%) respondents, while in a study on 406 industrial mine workers in Ghana, it was found to be 10%.[33] The relatively high rate of eye injury in our study could be due to the low patronage of protective eye wear (27.5%) among the mechanics as compared to 68% of protective eye wear usage in the other study.

Dandona et al conducted a research on eye care utilization patterns in an urban population in India and found that 43.2% reported they visited the hospital when they had eye related issues[34] comparable to findings in the current study at 66 (33.9%). The similarity in this majority response may be attributed to the fact that both studies were conducted in urban communities. Moreover, the higher proportion of respondents (89.6%) who were not aware of any eye health and safety standards is a common trend among industrial workers, as the current study is comparable to a research conducted among the workers of a steel rolling mill in Nigeria[35] with only 20.4% of workers aware of any eye health and safety standards.

In summary, we found various eye injuries and disorders among mechanics in the Cape Coast Metropolis. Eye injuries were prevalent among the mechanics in the Metropolis as the use of eye protection was low. The authors recommend more education and use of protective eye wear among all mechanics in the Metropolis. Equally, eye safety should be made an integral part of the public health agenda in the Cape Coast Metropolis.

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How to cite this article: Abu EK, Boadi-Kusi SB, Quarcoo PO, Kyei S, Owusu-Ansah A, Darko-Takyi C. Ocular health and safety assessment among mechanics of the Cape Coast Metropolis, Ghana. J Ophthalmic Vis Res 2016;11:78-83.

Source of Support: Nil. **Conflict of Interest**: None declared.