OCULAR MORBIDITIES ASSOCIATED WITH WORKERS IN THE BREWING INDUSTRY – A CASE STUDY OF THE COCA-COLA BOTTLING COMPANY

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APRIL, 2024.

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A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF OPTOMETRY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD DOCTOR OF OPTOMETRY (O.D) DEGREE IN OPTOMETRY.

APRIL, 2024.

CERTIFICATION AND APPROVAL

This is to certify that this research project titled **OCULAR MORBIDITIES ASSOCIATED WITH WORKERS IN THE BREWING INDUSTRY – A CASE STUDY OF THE COCA-COLA BOTTLING COMPANY** was carried out by **Precious Osarugue ORAVBIERE** in the Department of Optometry, Faculty of Life Sciences, University of Benin in partial fulfillment of the requirement for the Doctor of Optometry degree in the 2022/2023 Academic Session.

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DEDICATION

I dedicate this project to The Lord God Almighty, who has preserved my life and kept me in good health throughout my journey at the University of Benin.

I also dedicate this project to myself, for doing my best and giving this work my all.

I also want to dedicate this project to my wonderful parents, Pst. and A/P Presley Oravbiere their love, and unwavering moral and financial support, and to my siblings for their emotional support and care.

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ABSTRACT

Workplaces have a key role in developing eye disorders, due to the danger of accidents. Bottles holding carbonated beverages are potentially dangerous to the eye. Since beverage bottles may burst with regular handling and without provocation, production rules must be put in place to assist in eliminating defective bottles. The study was aimed at investigating the prevalence of ocular morbidities associated with the brewing company workers. This study employed a prospective cross-sectional study design and was carried out in the Coca-Cola bottling company, Benin City. A total of 90 participants consisting of 65 males (72.2%) and 25 females (27.8%) were enrolled in this study. Majority of the participants were between the ages of 24 and 29 years (28.89%) with a mean ± standard deviation of 31.3 ± 7.58 years. Also, 82.2% of the participants had their education at the tertiary level. Data was collected using questionnaires and eye examination. Descriptive statistics such as frequency, percentage, pie charts, mean and standard deviation, and chi-square were used to analyze and summarize the data. Findings from the study revealed that pterygium was the most prevalent ocular morbidity among workers in the brewing industry. Allergic conjunctivitis (11.1%), pinguecula (10.0%), presbyopia (5.6%), cornea opacity (2.2%), foreign body (2.2%), cataract (1.1%) and refractive errors (1.11%), were also prevalent. 62.2% of the participants were aware of activities that pose a risk of injury and packaging was found to be a major risk to eye injury among the participants (20.0%). 61.1% of them owned a personal protective eyewear and

47.8% of them who owned a personal protective eyewear owned safety goggles. In conclusion, there was no significant relationship between patients' ocular assessment and their areas of production ($p > 0.05$). Therefore, it is recommended that workers in the production units receive comprehensive training on the advantages of wearing ocular protective eyewear during their work and the potential consequences of failing to do so.

Keywords: Ocular morbidity, Bottling Company, Brewery, Ocular trauma, Personal protective eyewear.

CHAPTER ONE

1.0 INTRODUCTION

Ocular morbidity (OM) defines any eye illness independent of subsequent vision loss. Industrial environments account for a high number of ocular trauma cases, which contribute to visual impairment worldwide. It may vary from tiny wounds and foreign particles stuck in the eye to penetrating wounds that have the potential to result in blindness. Its avoidability gives rise to social and health difficulties (Shihakala *et al*., 2013).

Observations of ocular injuries are prevalent in general practice settings. These wounds may range in intensity from moderate strains on the eyes to severe injuries that can result in permanent damage, blindness, and loss of vision. Depending on their area of employment, a person may experience several ailments, including allergic conjunctivitis, cataracts, pterygium, macular degeneration, and retinal detachment (Yurt 2023).

However, most of the eye problems a worker would experience in the cause of work may be averted with the use of suitable eye protection such as safety goggles, face shields, and eye wash centers in the case of chemical splash (Alvi *et al*., 2011). According to Alvi (2011), occupational ocular injuries are mostly prevented if strict compliance with the usage of well-fitted and visible protective eyewear is adhered to. The use of adequate personal protection equipment has been reported to prevent 90% of eye injuries.

It is vital to warn individuals about the dangers and repercussions related to eye injury. In information exchange, lesson preparation, and cultural evaluation, worries about adopting preemptive steps remain a matter of debate. Updating equipment and sticking to workplace standards are jobs that demand continual effort (Kyriakaki *et al*., 2021).

Workplace safety awareness-raising activities and prudent preventative measures that are favorable to businesses and workers alike must be adopted. Efforts to enhance workplace

safety should comprise educating workers about eye health concerns and giving training on the topic (Mustafa *et al*., 2013).

According to Hirsheimer 2000, a bottling company is an industrial facility for mass manufacturing and bottling of beverages such as soft drinks. A soft drink bottling or production requires six primary processes each having particular safety hazards that need to be analyzed and addressed. They are as follows:

1. Treating water
2. Carbonating products and cleaning
3. Compounding ingredient
4. Carbonating product
5. Filling product
6. Packaging
7. Sanitation (Hirsheimer, 2000)

Top occupational eye injury causes in bottling industries include flying glass or metal shards; slippery or malfunctioning equipment; particles including metal shavings, wood splinters, or crystalline silica; spilled chemicals; and any combination of these or other threats.

1.1 BACKGROUND OF STUDY

1.1.1 Ocular Morbidities

According to the World Health Organization's (WHO) updated definition of health, ocular health is defined as a comprehensive state of physical, social, and mental well-being involving vision, rather than merely the absence of illness and infirmity. Therefore, an ocular morbidity might be regarded as an eye health condition.

Ocular co-morbidities that are found to be associated with persons working in this sector include:

- **Corneal Abrasion:** A corneal abrasion, commonly known as a scratched cornea or scratched eye, is a fairly frequent kind of eye injury. Photophobia, ocular erythema, and extreme discomfort are commonly brought on by a damaged cornea. Corneal abrasions are produced by a rupture or loss of cells in the cornea's corneal epithelium, which is its top layer (Wipperman and Dorsch, 2013)
- **Pterygium:** Pterygium is a growth of fleshy, pink tissue on the conjunctiva, the translucent membrane that surrounds and lines the eyeball. It's usually located on the side closest to the nose and expands toward the eye region. There are a number of variables associated with the origin of pterygium. The main risk factor is acknowledged to be exposure to ultraviolet radiation. However, other causes have also been identified such as dry weather, dust, rapid evaporation of the tear film, hereditary factors, ametropia, exposure to wind and microtrauma with dust particles or even toxic chemicals (Dhir *et al*., 1967)
- **Pinguecula:** A pinguecula is a benign, frequent degeneration of the conjunctiva that is distinguished by a grey, white-yellow mass on the bulbar conjunctiva. The word "pinguis," which implies fat or grease, is the origin of the phrase. It is often bilateral but may occasionally be unilateral. A pinguecula arises when the conjunctiva's tissue changes, forming a tiny hump that may contain calcium, fat, or both. People who labor outside for lengthy periods are prone to this illness.

Risk factors for pinguecula including exposure to wind, dust, UV radiation, and lengthy duration of working outside (Somnath and 2023).

Additionally, as individuals age, pinguecula seems to grow more widespread. Unless it causes pain, a pinguecula does not need treatment. Symptoms including discomfort, redness, and inflammation may be decreased with the use of eye drops or ointment.

Pinguecula may be surgically removed if its look disturbs the person. Consideration is offered to surgery when a pinguecula:

1. Grows across the cornea, since this might damage eyesight
2. Makes wearing contact lenses exceedingly painful for the person presently
3. The individual is highly and chronically itchy, even after applying ointments or eye drops

- **Allergic conjunctivitis:** Allergic conjunctivitis is widespread amongst workers in the food processing and agricultural industries who are often exposed to certain spices, fruits, and vegetables. Working outside is connected to excessive UV radiation exposure, which elevates the risk of allergic conjunctivitis (Peate 2007).

Mostly affecting the eyes, the symptoms consist of:

1. Watery, red, and itchy eyes
2. A burning sensation in the eyes
3. A dry, grainy feeling.
4. Light sensitivity
5. Swollen eyelids
6. Puffy eyes in the morning

However, avoiding environmental triggers is the best method to prevent allergic conjunctivitis, although it may not be simple to do so.

- **Cornea opacity:** The cornea is the clear component of the eye. Opacification of the cornea may develop from damage or scarring. This makes it harder for light to get through, which compromises vision. Cornea opacity is the loss of the cornea's natural transparency. Cornea opacities may occur after an eye trauma, a healed cornea ulcer, vitamin A deficiency, or a healed corneal injury. Because of the astigmatic effect, a

corneal opacity may cause reduced vision or loss of eyesight when thick opacity covers the pupillary area. People with cornea opacity may see a white or cloudy eye when they gaze in the mirror (Corneal Opacity Causes and Treatments | UVA Health, n.d.)

It is feasible to skip therapy for a minor cornea opacity that does not impede vision. Treatment options for cornea opacity resulting in compromised or lost eyesight include optical iridectomy, keratoplasty (Cornea Transplantation), photo-therapeutic keratectomy, cosmetic colored contact lenses, and scar tattooing (Corneal Opacity | Types of Corneal Opacity | Treatment of Corneal Opacity, n.d.)

- **Cataract:** According to the American Optometric Association discussion on cataract (Cataract, n.d.), a cataract is a thick, hazy region that occurs in the lens of the eye. It grows slowly and depending on the size and position, it may interfere with vision.

  Cataracts are widespread in elderly adults. Most cataracts form in persons over age 55, however, they sometimes arise in newborns and young children or as a consequence of trauma or drugs. Usually, cataracts grow in both eyes, although one may be worse than the other (Cataract, n.d.)

Types of cataracts

The lens is constructed of layers, like an onion. The outermost is the capsule, the layer within the capsule is the cortex, and the deepest layer is the nucleus. A cataract may occur in any of these places. Cataracts are called for their position in the lens:

1. A nuclear cataract is found in the middle of the lens. The nucleus tends to darken with age, shifting from clear to yellow and occasionally brown.
2. A cortical cataract affects the layer of the lens around the nucleus. The cataract appears like a wedge or a spike.

3. A posterior capsular cataract is present in the rear outer layer of the lens. This kind frequently grows more fast.

Causes & risk factors

Most cataracts are caused by age related changes in the eye's lens, which cause it to be hazy or opaque, according to the American Optometric Association, (Cataract, n.d). The development of cataracts may also be influenced by other factors, such as:

1. Diabetes mellitus: The risk of cataracts is increased in people with diabetes.
2. Drugs: Some drugs are associated with cataract formation. They include corticosteroids and chlorpromazine.
3. Ultraviolet radiation: Studies have shown an increased risk of cataract development due to unshielded UV light exposure.
4. Smoking: There is probably a link between smoking and increased lens cloudiness.
5. Alcohol: Several studies suggest increased cataract development in individuals with greater alcohol use compared with persons who had lower or no alcohol consumption.
6. Nutrition deficiency: although these findings are not consistent, studies suggest that the development of cataract may be associated with a lack of antioxidants such as vitamin C, vitamin E and carotenoids. Further research may demonstrate that antioxidants might help minimize cataract formation.
7. Family History: If a close family has had cataracts, there is a larger likelihood of acquiring a cataract (Cataract, n.d.).
    - **Refractive errors:** Refractive errors refer to visual impairments that cause difficulties in achieving clear vision. This phenomenon arises when the anatomical structure of your eye hinders the accurate convergence of light onto your retina, a delicate layer of tissue located in the posterior part of your eye. The National Eye

Institute provides information about refractive errors in their publication from 2024. (Refractive Errors | National Eye Institute, 2024)

Refractive errors are the most prevalent form of visual issue. There are 4 common forms of refractive errors:

1. Nearsightedness (myopia) makes far-away things seem hazy
2. Farsightedness (hyperopia) makes close things seem hazy
3. Astigmatism may make far-away and close objects seem hazy or distorted
4. Presbyopia makes it hard for middle-aged and older folks to see objects up close

The most frequent symptom is hazy vision. Other symptoms include:

1. Double vision
2. Hazy vision
3. Seeing a glare or halo surrounding bright lights
4. Squinting
5. Headaches
6. Eye strain (when your eyes feel weary or uncomfortable)
7. Trouble concentrating while reading or staring at a computer

1.1.2 Ocular Trauma

Ocular trauma may result in disease of the ocular surface and adnexa, extraocular muscles, orbital walls, eye, and optic nerve. Ocular trauma may lead to major sight- and eye-threatening complications (Heath Jeffery *et al*., 2022). Males in their working years are disproportionately impacted by eye injury, which is a substantial cause of blindness and monocular visual impairment. It is vital to seek prompt medical help after an eye injury to prevent irreversible repercussions.

1.1.3 The Burden of Ocular Morbidities

Vision disorders impose a considerable burden on the afflicted people, their caregivers, healthcare payers, and the national economy (Azodo and Ezeja 2014). In an endeavor to ensure the right to sight by eliminating avoidable blindness worldwide, especially in impoverished countries where 90% of blind people dwell, the World Health Organization (WHO) and an Alliance of International Agencies founded Vision 2020 in 1999.

There is a scarcity of population-based data on ocular morbidity internationally. The prevalence of ocular trauma is substantially greater in developing nations: 1.5 million of the 1.6 million injuries recorded worldwide (94%) occur in developing countries, as do 15.3 million instances of monocular blindness (Chepkener, 2013).

1.1.4 The Socioeconomic Cost of Ocular Trauma

The socioeconomic impact of ocular trauma is substantial comprising a large cost in human misery, economic inefficiency, and monetary loss (Yoon *et al*., 2011). In a study by Mustafa *et al*., (2013), it is stated that there is no sector whose employees are immune to the risk of eye injuries (as cited by Vats *et al*., 2008). Its direct and indirect expenditures are believed to go into millions of dollars yearly (Reidy *et al.*, 1998). Severe eye injuries need costly hospitalization, expert treatments, extended follow up, and rehabilitation (Funjika, 2011). This suggests that the expense of treating ocular, injuries via hospital admissions, surgeries, and drugs; work hours missed while such treatment; the increased maintenance of eye damage, and loss of timely revenue may all be avoided.

1.1.5 Factors Commonly Predisposed to Ocular Morbidities

Various variables such, as illiteracy or lower parents' education, poorer socio-economic status, and malnutrition were substantially linked with ocular morbidity (Prajapati *et al*., 2011). Poverty and illiteracy have been mentioned as factors responsible for many occurrences.

There is low adoption of conventional eye health care and an increase in the consultation of traditional healers in developing nations. Age, degree of education, employment, cost, and accessibility to these traditional healers have been described as determinants of this behavior. The unavailability of eye care facilities in rural regions has forced the adoption of free eye screening/treatment as a methods for educating and offering eye care to these rural people (Achigbu *et al*., 2016).

A research conducted by Ibrahim *et al*., (2021) discovered a strong link between individuals with diabetes mellitus and impaired vision (P-value <.001), maternal illnesses, notably diabetes, were identified as a risk factor for low visual acuity in their kids (P-value <.001). A significant association was observed between family history of eye illness and the degree of kinship to the afflicted participant (P-value <.001). There was a relationship between watching TV and present visual acuity (P-value <.001); as well as utilizing mobile phones and current visual acuity (P-value <.001).

1.1.6 Factors Predisposing to Ocular Morbidities in the Workplace

Several studies have demonstrated that not wearing suitable protective eyewear while at work might be a significant source of ocular morbidity around the workplace. Organic dust, chemicals, etc., which are exposed in the working environment, may potentially function as a cause. Employees should complete essential medical checkups and testing according to the nature of the job and the working environment. If the task is done and the surroundings are harmful for eye illness, suitable measures should be followed. The worker should also be tested before commencing work, and frequent eye tests should be done after starting work (Yurt 2023)

1.1.7 Personal Protective Eyewear Compliance

Several activities in the working environment or in leisure time involve an increased risk of eye injury. Many accidents might be averted by using suitable eye protection devices; nevertheless, the selection of appropriate eye protection equipment includes considerations of multiple features to obtain a maximum protection efficiency (Eppig *et al*., 2014). The reason for this in order of relevance or most usually claimed is pain when wearing PPE; poor eyesight through the glasses, and job demands.

Studies have demonstrated that there is a high degree of knowledge of the importance of PPE in the workplace which is not converted into practical practice. In research done among industrial workers in small-scale firms, most (85%) were associated with tasks posing eye damage risk, and were well aware of this. None of the workers utilized safety goggles or glasses all the time for operations that necessitated PPE use. Five percent never utilized PPE in the job (AlMahmoud *et al*., 2020).

1.1.8 Socioeconomic Contribution Of The Coca-Cola Bottling Company

The Coca-Cola Bottling Company besides creating employment opportunities of which most of them are breadwinners in their homes, especially for the youths who make up 70% of total unemployment in Nigeria, is also involved in the production of simple and affordable goods for the local market, thus saving the country's foreign exchange. Thus any accident among the workers would bring difficulty to the worker, his immediate family, the management, and the county as a whole. It is consequently vital to lower the incidence and prevalence of occupational health concerns. A research on occupational health risks among workers of these firms would be of tremendous relevance for the development and execution of safety measures and also give data for the evaluation of safety in the workplace.

1.2 STATEMENT OF PROBLEM

The frequency of ocular issues among Nigerians of various ages stemming from aging, traumatic, genetic, dietary, environmental and occupational causes characterize it as a key ignored health concern.

Although frequent thorough eye exams are crucial for the prevention and appropriate treatment of eye illness to preserve ocular health, a study done by Lee *et al*., (2009) has revealed that considerable percentages of patients do not seek eye care services, despite experiencing visual impairment.

The prevalence of ocular issues among Nigerians of various ages coming from aging, traumatic, genetic, dietary, environmental, and occupational causes define it as a key ignored health topic (Azodo and Ezeja 2014). Nigeria, like many impoverished nations, does not have population-based statistics on ocular morbidity. The available limited research implies that eye illnesses certainly represent a substantial public health burden despite most of them do not result in loss of vision (Muhammad and Dantani 2014). The leading causes of blindness and visual impairment in Nigeria were revised recently after a National blindness study.

Brewery sector personnel are among the occupational categories that face eye injuries and issues while they execute their profession. Some dangers in the work environment may be created by irresponsible handling of bottles such as shaking, falling, or jostling which may induce explosion, splash of chemicals used in cleaning, carbonating products, and treating water also blunt trauma from bottle caps and equipment. A comprehensive study addressing the ocular health difficulties encountered by workers in the brewing sectors is, however, missing. This research performs an evaluation of the ocular morbidities linked with the workers in the brewing business using the Coca-Cola Bottling Company situated in Edo state as a case study.

1.3 AIM AND OBJECTIVES

1.3.1 AIM

To identify the ocular morbidities associated with workers in the brewery industry.

1.3.2 OBJECTIVES

1. To identify the causes of ocular morbidities in workers in the brewery industry while they are on the job.
2. To ascertain the participants' knowledge and awareness of the dangers of ocular injuries that might arise from their jobs.
3. To ascertain the participants' practices and health-seeking behaviors towards the prevention of ocular injuries.

1.4 RESEARCH QUESTIONS

1. What are the contributing factors to ocular morbidities among workers in the brewing industry?
2. Are there specific ergonomic or environmental factors within brewing facilities that are significantly associated with the occurrence of ocular morbidities among employees?
3. To what extent are workers in the brewing industry aware of ocular safety protocols, and how does adherence to these protocols correlate with the prevalence of ocular health issues?
4. What are the current occupational health and safety practices related to ocular health in brewing companies such as protective eyewear and how effective are these measures in preventing ocular morbidities?

5. How can awareness and education programs be designed and implemented to improve ocular health knowledge among workers in the brewing industry, leading to a reduction in the prevalence of ocular morbidities?

1.5 SIGNIFICANCE OF STUDY

1. To create awareness among workers and management of the significance of adopting eye safety measures at work.
2. To urge management to make sure that workers get timely medical assistance if they experience an eye injury while at work.
3. To inform workers about predisposing factors of eye injury.
4. The results of this research are significant for designing targeted interventions, putting preventive measures in place, and boosting the overall ocular health outcomes of personnel in the brewing business.
5. This research will contribute to the body of existing literature.

1.6 DEFINITION OF TERMS

1.6.1 Ocular morbidity: Ocular morbidity may be described as the range of eye disorders which encompasses both visually impaired and non-visual impairing ocular ailments. It also defines any eye condition independent of consequent vision loss.

1.6.2 Bottling Company: A factory where drinks are placed into bottles with caps.

1.6.3 Brewery: A brewery or brewing firm is a business that creates and sells beer. The location at which beer is professionally brewed is either termed a brewery or a beerhouse.

1.6.4 Ocular trauma: An eye injury is any damage to the eye by external sources. It may be in the form of bruises, punctures, and/or scratches. They may develop from accidents, exposure to chemicals, or foreign objects in the eye. Eye injuries often encompass both surface injuries and intraocular injuries.

1.6.5 Personal protective eyewear: It is a protective gear for the eyes, and occasionally the face, intended to limit the risk of harm. Eye protection is often classified depending on the type of eyewear and the threat they are aimed to decrease. These categories include Spectacles with side protection; Goggles; Welding helmets; Welding Hand Shields; Non-Rigid Helmets (hoods); Face shields; and Respirator Face parts.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1 COCA-COLA BOTTLING WORKERS, A HIGH-RISK GROUP

Bottles holding carbonated beverages are potentially dangerous to the eye. Since beverage bottles may burst with regular handling and without provocation, production rules must be put in place to assist in eliminating defective bottles. In addition, adding plastic sleeves to

beverage bottles and the usage of plastic shatterproof bottles may lessen the potential of explosions and high-velocity pieces with the accompanying complication of severe vision impairment or blindness. Negligent handling of bottles such as shaking, dropping, or jostling may potentially induce an explosion (Bekibele *et al*., 2003). Besides manufacturing standards being carefully maintained, numerous ocular injuries connected to bottled carbonated drinks should be averted by health education (Zhu and Lou 2014).

The incidence of contusion-type closed-globe injury, varying degrees of hyphema, and vitreous hemorrhage were observed in all patients, in a retrospective review of ocular injuries due to metal caps of carbonated mineral water bottles carried out by Erdurman *et al*., (2013) and 2.4% of all open globe injuries were related to exploding bottles (Schrader *et al*., 2010)

A typical duty in forensic medicine is medical and biomechanical examination of injuries from blows to the head. Nentwig *et al*., (2021) did a research in the context of a criminal justice procedure, the harm potential of various striking weapons is relevant. Their study evaluated the risks of an attack with a 0.5 l beer bottle and 0.33 l coke bottle both made up of glass. Their study team struck 30 used empty 0.5-l beer bottles and 20 used empty 0.33-l Coke bottles manually on an aluminum dummy skull fitted on a force measurement plate, using acrylic and pig rind as a scalp surrogate. Analysis of beer and Coke bottles did not show a significant difference in fracture thresholds or energy transfer. Both glass bottles are possible to produce fractures to the face bones but cranial bone fractures are largely not to be anticipated. Blows with a 0.5-l Beer bottle or with a 0.33-l Coke bottle to the head may transmit up to 1.255 N and hence can produce serious blunt as well as acute trauma injuries.

Zhu and Lou (2014) performed a literature-based retrospective analysis using predetermined inclusion and exclusion criteria to provide a systematic review of ocular injuries induced by glass bottles containing carbonated drinks in China, which emphasized the injury circumstance and visual function loss. Demographic features of pressurized bottled drinks-

related ocular injuries were acquired and vision loss was assessed. A total of 26 relevant publications were discovered eligible for examination of the causative agent and patient demographics, of which 19 articles could be utilized for estimating vision loss and damage scenarios. Victims were typically pertinent workers (46.0%). Most of the trauma was substantial and even catastrophic. Final visual acuity was >10/20 in 29.2%, with significant final vision loss (<10/200) in 30.8%. Visual acuity may improve dramatically with therapy ($P<0.05$). They found that one in three ocular injuries from glass bottles containing carbonated beverages reveal serious vision loss with the relevant personnel most commonly wounded, followed by improper handlers or openers.

Workers at the Coca-Cola Bottling Company comprise an important high-risk group for various reasons,

1. The majority of the workers in this profession are young guys, a demographic that has been demonstrated not only to have a high risk of eye damage but also worse outcomes.
2. Workers may be of poor socioeconomic class with possibly low levels of education and literacy.
3. They are prone to experience recurring and severe injuries by many processes that further predispose them to even larger ocular and other ailments. They may suffer mechanical injuries from bursting bottles, chemical splashes, dust and/or flying, occasionally heated particles, etc.
4. Workers are typically taught on their work and so may not notice the danger of ocular damage, may wait to seek medical attention in the case of an accident, or may generally follow the bad attitude and practices of their mentors or trainers.

2.2 PRACTICE OF OCCUPATIONAL SAFETY REGULATIONS

An institutional-based cross-sectional research was undertaken by Tereza *et al*., (2017) to investigate the degree of self-reported safety practice and related variables among Dashen brewery workers. A stratified sampling technique was applied to choose 415 research participants and the data was obtained by employing a structured interview-administer questionnaire. An observational checklist was also employed to determine the answer provided by the respondent. The conclusion of their study suggested that 87.2% of the respondents reported adhering to excellent safety practices. Age, marital status, work status, attitude, safety and health training, and management support were shown to be key determinants for safety behaviors. They determined that the degree of self-reported safety practice in the research was excellent. Management commitment to safety and training of the personnel regarding safety and health is highly essential and should be offered routinely.

Osagiede *et al*., (2020) researched to analyze the knowledge of occupational risks and the practice of safety measures among welders in a suburban neighborhood in South-South, Nigeria. A structured questionnaire was provided to 58 welders in Ekpoma Edo State, Nigeria. Information was requested on their socio-demographic factors, their knowledge of work dangers, and the application of safety measures. Their workshops were examined for the availability and the expiry date of fire extinguishers. From their study, all the welders were aware of one or more occupational health issues. Safety goggles (81%), insulated safety gloves (56.9%), and work suits/coveralls (50%) were the commonly utilized safety clothing.

Hassan *et al*., (2017) performed a cross-sectional descriptive study to analyze the degree of awareness and reported complaints about occupational health risks among 70 welders of Lahore. An interview questionnaire was applied to measure knowledge and complaints, the ownership and usage of protective personal equipment (PPE), and socio-demographic variables. All of the responders were male with a mean age of 25.7 years. 54.3% of the

respondents were aware of welding as a danger to their health. 98.6% held at least 1 PPE contrasted to a research by Onyekwelu *et al*., (2019) where only seventy-seven respondents (67.5%) were aware of PEW; only 21.1% owned PEW, whilst the use level was 26.3%.

Tagurum *et al*., (2018) performed descriptive cross-sectional research to investigate the knowledge of work risks and the adoption of PPE amongst welders in Jos City. All individuals were men with a mean age of 24.6±7.7 years. From their study, 293 (99.3%) were aware of occupational dangers in welding. Goggles were the most often worn PPE 98%, then gloves 65.4%, boots 58%, overalls 36.3%, facemasks 30.6% and earplugs 12.9%. A statistically significant ($p \leq 0.05$) link was established between employment patterns as well as working hours per day and the usage of safety equipment. Most of the participants had a good understanding of welding-associated health concerns, risks, and safety equipment, and the application of safety devices was less than ideal.

Abraham *et al*., (2015) performed a cross-sectional research to investigate the awareness level and protective eye equipment usage profile among workers in the Uyo Mechanic Village. 109 participants were enrolled in this research, 107 (98.2%) were males and two (1.8%) were women with a mean of 37.6 ±9.2 years, and the age range was 18–62 years. Ninety-five individuals (87.2%) were not using any sort of eye protection at work, 85 (78%) had never heard of protective eyewear at work, while 91 (83.5%) were not taught utilizing protective eye-wear. Eleven instances (73.3%) experienced occupation-related ocular damage. They determined that job-related eye injuries are widespread in their cohorts mostly due to ignorance or non-use of protective eye equipment.

Adak *et al*., (2024) did a cross-sectional research to find out the morbidity trends among the metal workers working in Northwestern Uttar Pradesh, district Moradabad. Eye Injury was the most prevalent complaint at work. The age of the metal workers, period of employment & welding hours per day were connected with ocular morbidities among the metal workers. In

their study, among 100 metal workers, 18% of workers were suffering from occupational eye damage. 98% metal workers population did not have any personal protective eye equipment. 86% of them thought that the usage of protective eyewear was not essential. They found that there is a need for occupational health safety awareness services for metal workers in Moradabad as well as across Uttar Pradesh.

Ezinne *et al*., (2021) performed a cross-sectional research to investigate occupational ocular injuries and the adoption of eye protection equipment among sawmill workers in the Ojo local government area of Lagos State, Nigeria. A total of 215 sawmill workers with a mean age of 37.08 ± 12.07 years participated in the research. A majority (55.8%) of the participants were male (93.7%), and a majority were 21–40 years old (55.8%). 78.6% of the participants were aware of occupational eye injuries and 17.7% utilized ocular safety equipment. From their study, they discovered that the biggest hurdle to the usage of eye protection equipment was unavailability (43%). Workers who were aware of ocular dangers ($p < 0.03$), and who did not utilize protective eye equipment ($p < 0.02$) were substantially related to occupational ocular injuries compared to others. The frequency of occupational ocular injuries and the adoption of eye protection equipment among the sawmill workers in their research were similar to results from previous studies. They indicated that eye protection equipment should be supplied for sawmill workers and regulations should be put in place to ensure frequent usage

2.3 PREVALENCE OF OCULAR MORBIDITIES IN THE GENERAL POPULATION

Ocular morbidities are regarded as a key contributor to debilitating disorders in both poor and rich-resourced nations (Omoto *et al*., 2023). The entire worldwide burden of eye illnesses is estimated at 61.4 million Disability Adjusted Life Years (DALYs) which accounts for 4% of total Disability Adjusted Life Years. There have been significant institutional partnerships on accomplishing Vision 2020-right to sight, which is a worldwide program aiming at lowering avoidable levels of blindness has strengthened institutional cooperation in fight against

blindness. Some eye diseases that impact a person's quality of life but do not result in blindness have been disregarded in favor of those causing visual impairment. Omoto *et al*., (2023) did a descriptive community-based cross-sectional research on inhabitants of Mathare slums in Nairobi County, Kenya, receiving treatment at medical camps. They were submitted to an objective eye examination aiming at establishing ocular morbidity patterns, causes, and distribution. Patients over 10 years old who reported with eye-related restrictions at the medical camps were taken as the research subjects. The findings suggested a majority of respondents (34.44%) were diagnosed with conjunctiva illnesses. 30.29% were diagnosed with refractive defects, 11.62% with cornea, and 8.30% with lens disorders. On distribution, conjunctiva illness (34.44%) impacted most of the respondents, and the majority of these respondents (19.5%) aged between 10 and 20 years were acknowledged to be atopic. A refractive error also regularly impacted 30.29% of the subjects, with Presbyopia (7.46%) being the largest kind of refractive error. Cataracts (7.05%) and dry eye condition (6.22%) were more prevalent among individuals aged over 40 years. Most of the respondents (43.5%) were found to have diseases stemming from developmental factors, followed by allergies (24.1%) and refractive problems (10.4%).

Chinawa *et al*., (2020) did a community-based cross-sectional descriptive study in Rumuokwuta village in Rivers State. An interviewer-administered questionnaire was utilized to acquire socio-demographic and clinical presentation information. Distant visual acuity was examined at 6 m using the Snellen's chart while close vision evaluation was at 33 cm with a Sussex vision R near vision chart. External eye examination was done with a pen touch while fundoscopy was using a direct ophthalmoscope. A total of 114 patients were evaluated. The mean age was 41.41± 15.49 years. The male-female ratio was 2:3. About 70.5% and 76.2% respectively in the Right Eye and Left Eye had normal vision better than 6/18, whereas 27.1% and 21.9% respectively in the Right Eye and Left Eye had poor vision (VA between 6/18 and

6/60). About 2.6% in each eye were blind. The three most prevalent eye diseases were Glaucoma (13.95%), Refractive error (13.02%) and Presbyopia (12.56%). They determined that the commonest causes of ocular morbidity in their research include glaucoma, refractive error, and presbyopia and that the age distribution of the study region was a substantially linked factor in the frequency of visual impairment and blindness.

Ogbeanu Achigbu *et al*., (2016) carried out a retrospective review of data generated from self-selected patients during the free eye screening organized in each of the 3 senatorial zones of Imo state by The Federal Medical Centre Owerri, Imo state, to determine the pattern and prevalence of ocular disorders in some rural areas of Imo state where primary eye care facilities are scarce to make recommendations to the health authorities for proper planning of eye care services in the state. A total of 1973 participants which comprised 1111 (56.3%) girls and 862 (43.7%) men yielding a ratio of 1.3:1, engaged in the outreach. The most prevalent causes of ocular morbidity were refractive error (31.6%), glaucoma (23.5%), presbyopia (17%), and, cataract (12.5%). Refractive error, glaucoma, and, cataracts were strongly linked with age and sex whereas presbyopia was only favorable with age. They found that there is an urgent need to create primary eye care services in these distant and rural locations to accomplish the Vision 2020 objective of eradicating avoidable blindness.

Zalwango *et al*., (2021) carried out a descriptive cross-sectional research on convicts at Luzira jail. The research comprised both male (334) and female (33) convicts utilizing the proportional stratified random sample. Data on socioeconomic demographic variables, medical, incarceration factors, and optical examination was obtained using a questionnaire. Results indicated that the total ocular morbidity was determined to be 49%. The most prevalent ocular morbidity comprised; presbyopia (27.4%), allergic conjunctivitis (19.6%), and cataracts (11.4%). Other problems included; refractive errors, pterygia, ocular atrophy, and vitamin A insufficiency. There was a statistically significant connection between ocular

morbidity and age (OR 11.96, CI 0.85–2.74), trauma (OR 5.21, CI 1.52–17.87), and non-prison food (OR 0.45, CI 0.26–0.79).

Agrawal *et al*., (2020) did a prospective, cross-sectional, school-based observational research in Raipur, Chhattisgarh, India to determine the incidence of several ocular morbidities in school children (5–15 years) employing a complete mobile eye unit in Central India. A total of 1557 eligible school-going youngsters in the age range of 5–15 years were examined throughout the research. Random selection was done to distribute schools (n = 29) and pupils from diverse urban and rural (836 versus 721) schools. The major purpose was to determine the prevalence of ocular morbidities in school-going children in Raipur district, India. The secondary purpose was to investigate if the geographical location (rural vs urban), age group, and gender led to any changes in ocular morbidity patterns. The research comprised 691 (44.4%) males and 866 (55.6%) girls. Ocular morbidity was detected in a total of 331 (21.2%) children. Vitamin A insufficiency was the most prevalent cause of ocular morbidity, found in 156 (10%) children, followed by refractive error (81, 5.2%). Myopia was substantially greater in urban school students (4.3%) compared to rural children (1.9%) (P = 0.002). The older age group exhibited a larger prevalence (7.6%) of refractive error, notably myopia, compared to the younger age group (2.2%) (P < 0.001). They observed that Vitamin A insufficiency prevalence was substantially greater suggesting lost chances for vitamin A supplementation at a younger age. Refractive error was more common in the urban population as well in the older age range (11–15 years), suggesting a need for regular eye examination.

2.4 WORK-RELATED OCULAR MORBIDITIES

Workplaces have a key role in developing eye disorders, due to the danger of accidents. Ethem-Ay *et al*., (2022) did a research to examine the ocular health of industrial workers by measuring the prevalence of foreign body damage, refractive error, dry eye, and pterygium/pingueculae, as well as the variables affecting these disorders. Their investigation

includes on-site assessments of workers from an industrial region housing marble processing firms and metal sectors. Data such as refractive error, foreign body injury-related corneal nephelium, pterygium/pingueculae presence, and Schirmer test-assisted dry eye assessment were also gathered. The average age of workers utilized in their research was 35.78±10.05 years, with a female-to-male ratio of 20:220. The majority of workers had finished basic education (56.3%), smoked >1 cigarette/day (57.6%), and did not need any assistive aids for bodily functions (88.3%). On average, working hours/week were 55.07±8.79, and working years were 5.99±7.00. Dry eyes were reported in 31 (22%), and 35 (34%) marble and metal workers, respectively (p=0.042). 11 (7.9%) marble workers and 29 (28%) metal workers suffered foreign body ocular injury-related corneal nephelium (p=0.0001). Furthermore, pterygium/pingueculae were found in 17 marble workers (12.3%) and three metal workers (3%) (p=0.009). However, they found that health is crucial, and regular ocular health screening in industrial workers, as well as workplace safety measures, should be undertaken to avoid possible occupational mishaps.

Similarly, a cross-sectional investigation was carried out by Ukoh and Obinna (2020). The research involved 400 participants and was done in three separate breweries in Nigeria. Questionnaires and eye tests were utilized to obtain data. Findings from their research indicated that pterygium (30%, 24.8% & 24.1% respectively) was the greatest frequent ocular morbidity among workers in the brewing business. Pinguecula (21.5%, 23.2% & 17.9%) and allergic conjunctivitis (18.5%, 13.6% & 7.6%) were also frequent. Correspondingly, exposure to foreign body/dust particles (33.1%, 33.5% & 29.2) accounted largely for the causes of ocular morbidities among these workers.

Kumah *et al*., (2017) performed a cross-sectional research among five randomly selected zones of auto mechanics to identify the incidence of ocular disorders and explore safety procedures among car mechanics at 'Suame Magazine' region in the Kumasi metropolis. A

hundred and fifty (150) car mechanics (mean age of 34.4 ± 1.2 years) were sampled for the research. History obtained from subjects includes individuals' demographics, ocular, and work history. Ocular examination comprised distant and near visual acuity, cover tests, ophthalmoscopy, and refraction. Diagnoses were based on the existence of a condition(s) in one or both eyes. Out of the 150 responses, 85.3% were men and 14.3% were girls. The total prevalence of eye disorders was 100.0%. Pinguecula (33.3%) was the most frequent condition, followed by dry eyes (22.7%), pterygium (15.3%), allergic conjunctivitis (4.7%), bacterial conjunctivitis (4.0%), refractive errors (8.0%) and presbyopia was (8.0%). The least frequent eye disease was macula scar (1.3%). Many of the respondents (90%) knew about personal protection equipment but few of them utilized them at work. There was a significant connection between the occurrence of an eye problem and many years of employment as an auto mechanic ($p< 0.0001$). They found that the survey demonstrated a high ocular morbidity rate and there was typically poor voluntary attendance to clinics for eye exams by the auto mechanics at the 'Suame- Magazine' region in the Kumasi metropolis.

In a cross-sectional study carried out by Praveena *et al*., (2022) to investigate the incidence and pattern of ocular diseases related to chronic exposure to arc welding among vocational welders in Western Rajasthan. Ninety welders and ninety non-welders took part. Sociodemographic information was acquired in the community, and a complete ocular examination was done in tertiary care facilities. It was discovered that the majority (93.33%) of welders had at least one ocular symptom, which was greater than the non-welders, i.e., 26.67% ($P < 0.01$). Among welders, the most prevalent conjunctival sign was congestion (36.11%). The frequency of phototoxic maculopathy was observed at 56.67% among welders and 7.78% among non-welders ($P < 0.01$). All the welders used to use merely goggles as protective equipment. The prevalence of maculopathy was observed to be lower among strongly dedicated welders than infrequent users. None of the sociodemographic

characteristics was observed linked with the stringent wearing of eyewear among welders. However, they determined that persistent exposure to arc welding is related to increased eye illnesses including phototoxic maculopathy. Policies governing personal protection equipment use and safety at workplaces should be enforced thoroughly, including in small-scale, unorganized industries.

In 2019, Hirut *et al*., performed an institution-based cross-sectional research on 542 manufacturing and construction workers in Gondar town. A pre-tested questionnaire was utilized to gather data utilizing face-to-face interviews. The prevalence of occupational ocular damage was 31.4% (95% CI, 27.2–35.5). Employment pattern (temporary workers) (AOR: 1.84, 95% CI: 1.14–2.95), health and safety training (AOR: 2.22, 95% CI: 1.06–4.66), non-use of eye safety device (AOR: 7.43, 95% CI: 4.44–12.43), and job category (woodwork (AOR: 0.56, 95% CI: 0.32–0.97), and brickwork (AOR: 2.19, 95% CI: 1.08–7.21) had statistically significant with occupational ocular injury.

Gobba *et al*., (2019) reviewed the medical records of the Ophthalmological Emergency Department (OED) of Modena University Hospital. There were 13,470 OED accesses in 2014 and in 754 instances an occupational eye injury occurred. Although the incidence of job-related eye injuries (3%) was decreased compared to earlier published research, the absolute number was still important, highlighting the need for more appropriate prevention, notably in metal work, construction work, and agriculture, where the worst prognoses were recorded. They concluded that intervention programs must be implemented as early as possible in the working life, considering that the frequency in younger workers was about double that of the oldest age class (3.5% vs. 1.8%), and special attention should also be given to foreigners, who have a 50% higher injury risk.

In 2021, Vishwaraj *et al*., did a retrospective record-based cross-sectional research among electronic equipment manufacturing workers. Data collected included sociodemographic

characteristics of the workers and details of periodic medical check-ups. Results indicated that 10.1% (11) of the 109 workers in the electronic manufacturing business were obese, with a BMI surpassing 30, 24.8% (27) had hypertension (>140/90), and 31.2% (34) had diabetes mellitus, with a HbA1c more than 6.5. Additionally, 39.4% (43) and 24.8% (27) exhibited near vision problems and distant vision deficiencies, respectively. Abnormal findings were detected in 42.2% (46) of the lung function tests, 0.9% (1) of the hearing tests, and 4.6% (5) of the ECG tests. While all PAP smear findings for female workers were normal, 0.9% (1) of male workers had increased PSA values.

Kyriakaki *et al*., (2021), ran a literature search utilizing key phrases in PubMed to extract the most relevant papers on ocular injuries, from an occupational point of view. Seventeen relevant articles were included out of seventy-two. Eight related articles were located from the references of the articles contained and were also included. The total number of papers for this systematic search analysis was twenty-five. The collected information was tabulated in the Appendix. Most of the mentioned publications were original pieces. Many investigations were retrospective and cross-sectional with an acceptable rate of participant recruitment when reported. Most of the eye injuries happened in the workplace. Common eye injuries were caused by foreign bodies and corneal abrasions. High-risk vocations included welders, farmers, metalworkers, and grinding, building, and manufacturing workers. Most of the injuries might be avoidable by employing sufficient protective eye devices (PED) but effective protection is a more involved procedure than it looks.

Work-related eye injuries have been recorded with a range of epidemiologic and clinical features. Ahn *et al*., (2020) performed a multicentre, retrospective, observational analysis utilizing a prospective eye injury registry. They wanted to determine epidemiologic aspects of work-related eye injuries and risk variables linked with severe damage in a big metropolitan metropolis. They comprised individuals with work-related eye injuries at four tertiary

teaching hospitals in Daegu, South Korea. Severe injuries were classified when participants satisfied one or more of the following criteria: 1) presented with open globe injury; 2) needed emergency eye surgery or surveillance after hospitalization; 3) developed eye injury-associated sequelae or 4) diminished final visual acuity. The research covered 1,424 patients. One hundred seventy-three patients (12.1%) sustained serious injuries. Among the individuals, 61 patients (4.2%) had eye injuries despite the use of protective eyewear at the time of injury. Multivariable logistic regression analysis identified age ≥70 years (odds ratio: 4.02, 95% confidence interval: 1.77-9.15), hammering/nailing (6.80, 2.80-16.53), and mowing (4.87, 1.77-9.15) as activities that imparted a high risk of ocular trauma with serious damage. They found that age above 70 years, hammering/nailing, and mowing were risk factors for serious damage from work-related ocular trauma.

Chaikitmongkol *et al*., (2015) conducted out a prospective case series to assess demographics, clinical features, and variables associated with work-related eye damage in Northern Thailand. Their research covered eye injuries from any source treated at a university-based hospital in Northern Thailand from March 2007 to June 2008. The patient's employment, kind of activity at the time of injury, alcohol use and eye protection have all been examined with a comprehensive eye examination and routine therapies. The Birmingham Eye Trauma Terminology System has been used to describe eye injuries. Demographic and clinical data were gathered using a form derived from the United States Eye Injury Registry. Of the 101 eyes (97 patients) with a work-related injury, 94% were males with a mean age of 39.5 ± 12.9 years (range, 19-72 years). Ninety-eight percent (95/97 patients) did not utilise protective eyewear. Open-globe injuries were identified in 58/101 (57%) eyes. Agricultural workers suffered a larger number of open-globe injuries (37/58 eyes, 64%), while construction workers experienced a higher number of closed-globe injuries (25/43 eyes, 58%). In multivariable logistic regression models, nailing (odds ratio, 97.2; 95% confidence interval, 2.6-363.4; P =

0.01) and motorized grass trimming (odds ratio, 14.3; 95% confidence interval, 1.0-206.2; P = 0.05) were significantly associated with open-globe injuries when compared with closed-globe injuries. Significantly larger proportions of eyes with open-globe injuries had ultimate vision comparable to legal blindness (visual acuity, <3/60) compared with closed-globe injuries (42% vs 12%, P = 0.001). They found that work-related open-globe injuries were considerably more prevalent among agricultural labourers in Northern Thailand. Protective eyewear should be extensively pushed among personnel involved in nailing and mechanised lawn clipping.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 RESEARCH DESIGN

This was a prospective cross-sectional study.

3.2 RESEARCH LOCATION

This research was conducted at the staff clinic of the Coca-Cola bottling company in Eyaen, Benin City, Edo state.

3.3 STUDY POPULATION

The research population was made up of the production unit workers of the Coca-Cola bottling company who matched the inclusion criteria.

3.4 SAMPLING TECHNIQUE/SAMPLE SIZE DETERMINATION

3.4.1 Sampling Technique

A convenience sampling technique was adopted throughout this study.

3.4.2 Sample Size Determination

The minimal sample size was estimated as follows:

$N = \frac{Z^2 p(1-p)}{d^2}$ (Charan and Biswas, 2013).

Z = standard deviation chosen as 1.96 which corresponds to a 95% confidence level

P = 19% (Muhammad & Dantani, 2014).

D = 0.05

$N = \frac{1.96^2 \text{ x } 0.19(1-0.19)}{0.05^2}$

$N = \frac{3.8416 \text{ x } 0.19(0.81)}{0.0025}$

$N = \frac{0.5912}{0.0024}$

N = 236.49

For a sample size of less than 10,000 (Cochran, 1963)

$N_f = \frac{n}{1+\frac{n-1}{N}}$

N = 120 (the estimate of the population size)

$N_f = \frac{236.49}{1+\frac{236.49-1}{120}}$

$= \frac{236.49}{2.962}$

$N_f = 79.8$

~80 (this will be the minimum sample size)

10% of 80 = 8.0

Adjusting for a 10% attrition rate provides 80 + 8.0 = 88.0

However, 90 subjects were employed for this study.

3.5 RESEARCH MATERIALS

Research materials include:

1. Questionnaire Papers
2. Ocular assessment papers
3. Keeler Ophthalmoscopes
4. Snellen's visual acuity charts at 6m and 40cm
5. Penlights.
6. Duracell batteries

3.6 SELECTION CRITERIA

3.6.1 Inclusion Criteria

Those who work in the production unit of the Coca-Cola bottling company, and were willing to participate in the study.

3.6.2 Exclusion Criteria

1. Workers at the production unit of the Coca-Cola bottling company who did not desire to participate in the research.
2. Individuals who work outside the bottling company.
3. Workers whose job demands did not enable them to participate.
4. Workers at the Coca-Cola bottling company who work in other units

3.7 DESCRIPTION OF PROCEDURE

The procedure was carried out after the consent from the managing director was gained.

The participants were informed of the research and the clinical procedures to be carried out were carefully described.

3.7.1 Distribution of Questionnaire

A structured questionnaire was provided to the individuals to ascertain the source of any ocular morbidity that may have happened during their working hours and assistance was rendered when appropriate. This questionnaire was pretested on eight randomly selected workers of the Coca-Cola bottling plant to determine its effectiveness. The objective of this was to eliminate ambiguity and to guarantee that the participants had a clear grasp of the research.

This questionnaire comprised four components.

- Part A gathered the demographic data of the participants.
- Part B focused on the participants' training and work experience.
- Part C sought to gather information on the participants' knowledge and awareness of ocular injuries that may occur as a result of their work.
- Part D gathered information on the ocular health-seeking behavior and practices among the participants toward these ocular injuries that may occur as a result of their work.

Consent was obtained from each participant verbally after which the following clinical tests were carried out at the staff clinic.

3.7.2 Visual Acuity

Visual acuity was tested at both 6m and 40cm using a Snellen visual acuity chart, monocularly and binocularly.

3.7.3 External Examination

The eyelids, eyebrows, eyelashes, cornea, conjunctiva, sclera, pupil, iris, and lens were examined for any ocular injury, using a penlight.

3.7.4 Monocular Direct Ophthalmoscopy

Ophthalmoscopy was done to check the posterior part of the eye.

All results from the eye examination were noted in a recording note and appended to the individual's questionnaire.

3.8 DATA ANALYSIS

The acquired data from this research were analyzed using descriptive statistics such as frequency, percentage, pie charts, mean and standard deviation, and chi-square as processed by the Statistical Package for Social Sciences (SPSS) version 25.0

A p-value of <0.05 was deemed as statistically significant.

3.9 LIMITATIONS OF STUDY

1. Participants' prejudice: There is a chance of bias from the participants when completing the questionnaire.
2. All parts of the bottling company could not be assessed to check the general adherence to the usage of Personal Protective Eyewear by the workers.
3. Time constraints and schedule of the workers.

3.10 ETHICAL APPROVAL

- Ethical clearance was acquired from the Research and Ethics Committee of the Department of Optometry, University of Benin, Benin City.
- A letter was written and submitted to the managing director of the Coca-Cola bottling firm in Edo state requesting authorization and approval. Furthermore, informed permission was obtained and confirmed by the study subjects verbally.
- To guarantee anonymity, no personal identifying information such as name or hometown was gathered throughout this investigation.

CHAPTER FOUR

4.0 RESULTS AND DATA ANALYSIS

TABLE 4.1: Distribution of Socio-Demographics of Participants

	Response	Frequency (n)	Percent (%)
Age	18-23	16	17.8
	24-29	26	28.9
	30-35	16	17.8
	36-41	16	17.8
	42 and above	16	17.8
	Total	90	100.0
Gender	Male	65	72.2
	Female	25	27.8
	Total	90	100.0
Level of	Secondary	16	17.8

Education	Tertiary	74	82.2
	Total	90	100.0

Majority of the participants were between the ages of 24 and 29 years (28.89%) with a mean ± standard deviation of 31.3 ± 7.58 years. Majority of the participants were of male gender (72.2%). Majority of the participants had their education at the tertiary level (82.2%).

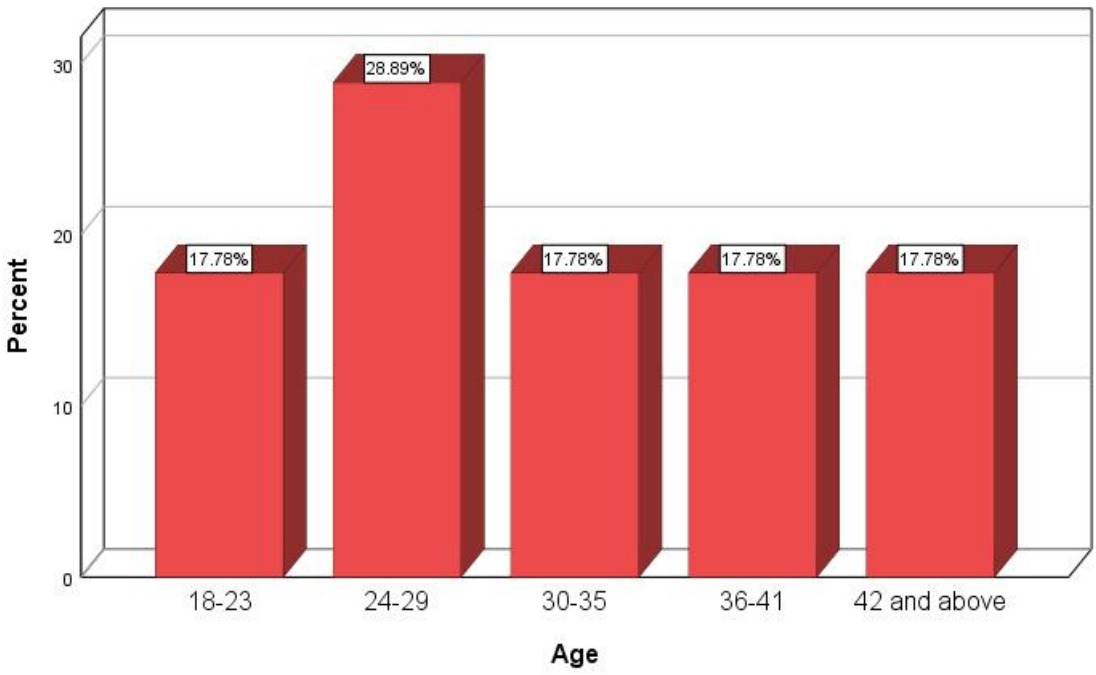


FIGURE 4.1: Age Distribution of Participants

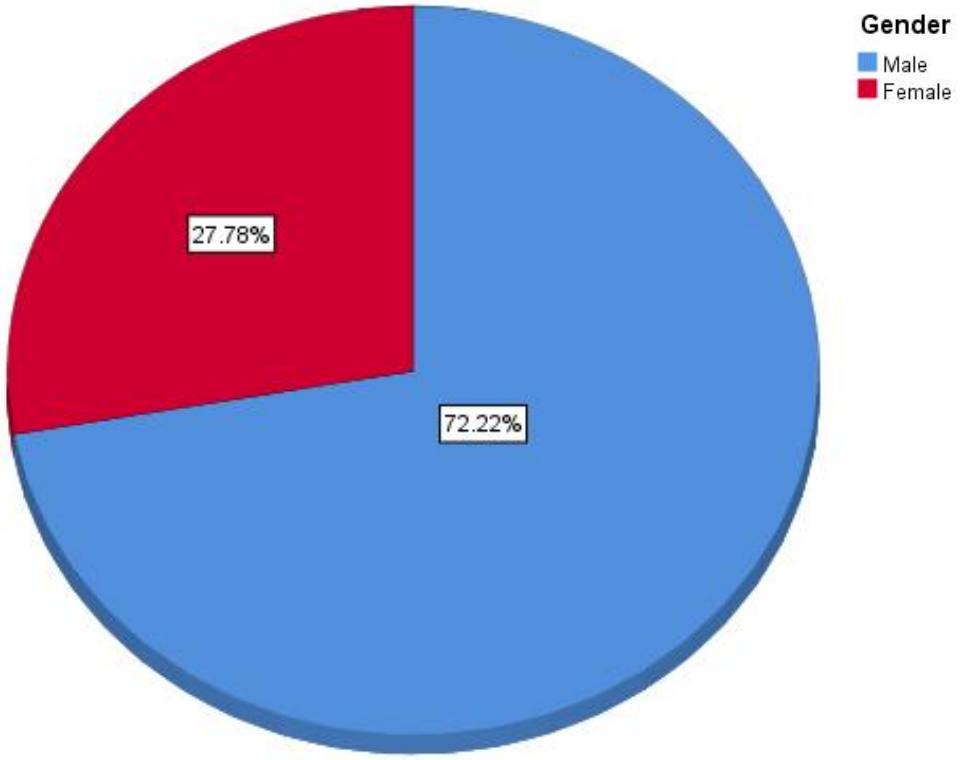


FIGURE 4.2: Gender Distribution of Participants

TABLE 4.2: Training and Work Experience of Participants

	Response	Frequency (n)	Percent (%)
What area of production are you involved in?	Treating water	5	5.6
	Compounding ingredients	8	8.9
	Carbonating product	9	10.0
	Filling product	15	16.7
	Packaging	19	21.1
	Sanitation	8	8.9
	Safety	26	28.9
	Total	90	100.0
How long have you worked in this industry?	Less than one year	32	35.6
	1 to 5 years	43	47.8
	6 to 10 years	9	10.0
	11 to 15 years	3	3.3
	16 to 20 years	1	1.1
	> 20 years	2	2.2
	Total	90	100.0
How many hours do you work daily?	8 hours	39	43.3
	9 hours	14	15.6
	10 hours	33	36.7
	11 hours	1	1.1
	12 hours	3	3.3
	Total	90	100.0

Majority of the participants worked in the safety area of production (28.9%) and had worked for 1 to 5 years in the bottling company (47.8%). Majority of them work for 8 hours in a day (43.3%).

TABLE 4.3: Knowledge and Awareness of Occupational Eye Safety Among Participants

	Response	Frequency (n)	Percent (%)
Are you aware of any activities in your daily work that pose a risk of eye injury?	Yes	56	62.2
	No	34	37.8
	Total	90	100.0
Can you name any activities you or your colleagues perform that pose a risk of eye injury?	None	18	20.0
	Treating water	11	12.2
	Carbonating product	16	17.8
	Compounding ingredients	8	8.9
	Filling product	11	12.2
	Packaging	18	20.0
	Sanitation	8	8.9
	Total	90	100.0
Do you know how any of these injuries may be prevented?	Through use of personal protective equipment	69	76.7
	I don't know	21	23.3
	Total	90	100.0
Do you wear any form of personal protective equipment for your eyes?	Yes	52	57.8
	No	38	42.2
	Total	90	100.0
Where did you first learn about occupational eye safety?	Radio	13	14.4
	Television	17	18.9
	Health workers	25	27.8
	Trainers/mentors	14	15.6
	Teachers/lecturers	21	23.3
	Total	90	100.0
Do you feel well informed about occupational eye safety?	Yes	34	37.8
	No	56	62.2
	Total	90	100.0

Majority of the participants (62.2%) are aware of activities that pose a risk of injury. Amongst all the activities, a large number of the participants noted packaging as a risk to eye injury (20.0%) and know that the use of personal protective equipment (76.7%) can prevent it. Majority of the participant derive their knowledge about occupational eye safety from health workers (27.8%) and do not feel that they are well informed about it (62.2%).

TABLE 4.4: Ocular Health-Seeking Behavior and Practices among Participants

	Response	Frequency (n)	Percent (%)
Do you own any form of ocular personal protective equipment?	Yes	55	61.1
	No	35	38.9
	Total	90	100.0
What type do you own?	Safety goggles	43	47.8
	Face shield	8	8.9
	Safety spectacle	7	7.8
	None	32	35.6
	Total	90	100.0
Do you use any of the ocular personal protective equipment?	Yes	55	61.1
	No	35	38.9
	Total	90	100.0
If yes, how often do you use it?	Always	30	33.3
	Sometimes	25	27.8
	Never	35	38.9
	Total	90	100.0
Do you rub your eyes with your hands while working?	Yes	57	63.3
	No	33	36.7
	Total	90	100.0
How regularly are your devices replaced?	<6 months	25	27.8
	1-2 years	19	21.1
	>2 years	46	51.1
	Total	90	100.0
If you are provided with an ocular personnel protective equipment, will you use it?	Yes	83	92.2
	No	7	7.8
	Total	90	100.0
Do you receive regular eye examinations as part of your occupational health program?	Yes	43	47.8
	No	47	52.2
	Total	90	100.0
Are there any additional protective measures you think should be implemented to improve ocular health in the	Hand gloves	1	1.1
	Hand washing	1	1.1
	None	75	83.3

workplace?	Provision of PPEs	1	1.1
	Regular eye check-up	8	8.9
	Sensitization	4	4.4
	Total	90	100.0

Majority of the participants (61.1%) owned ocular personal protective equipment and a large number of them owned safety goggles (47.8%). Most of the participants (92.2%) noted that they used ocular personal protective equipment in which their usage was never often (38.9%) but were more willing to use it if they were being provided (92.2%). Majority of the participants rub their eyes with their hands while working (63.3%). Their devices are replaced mostly more than 2 years (51.1%) and majority do not receive regular eye examinations as part of their occupational health program (52.2%). Majority of the participants do not think that any additional measures should be implemented to improve ocular health in the workplace (83.3%).

TABLE 4.5: Distribution of Ocular Morbidities among Participants

Ocular Morbidity	Frequency (n)	Percent (%)
Allergic conjunctivitis	10	11.1
Cornea opacity	2	2.2
Pterygium	18	20.0
Pinguecula	9	10.0
Refractive errors	1	1.1
Presbyopia	5	5.6
Cataract	1	1.1
Foreign body	2	2.2
No ocular morbidities	42	46.7
Total	90	100.0

Majority of the participants with ocular morbidities had Pterygium (20.0%).

TABLE 4.6: Cross-Tabulation of Ocular Morbidities and Participants' Area of Production

	Area of Production							
	Treating water	**Compounding ingredients**	**Carbonating product**	**Filling product**	**Packaging**	**Sanitation**	**Safety**	**Total**
Allergic conjunctivitis	0	0	2	0	4	2	2	10
Cornea opacity	0	0	0	0	2	0	0	2
Pterygium	1	2	0	7	3	0	5	18
No ocular morbidities	4	3	4	6	8	4	13	42
Pinguecula	0	1	2	1	1	0	4	9
Refractive error	0	0	0	0	0	1	0	1
Presbyopia	0	2	0	1	1	1	0	5
Cataract	0	0	0	0	0	0	1	1
Foreign body	0	0	1	0	0	0	1	2
Total	5	8	9	15	19	8	26	90

There was no significant relationship between participants' ocular assessment and their areas of production ($p > 0.05$).

TABLE 4.7: Cross Tabulation of Age of Participants and Their Ocular Assessment

Ocular Assessment						
	Age					Total
	18-23	24-29	30-35	36-41	42 & above	
Allergic conjunctivitis	2	7	0	0	1	10
Cornea opacity	0	0	1	0	1	2
Pterygium	0	2	5	4	7	18
No ocular morbidities	12	12	10	7	1	42
Pinguecula	2	3	0	2	2	9
Refractive error	0	0	0	1	0	1
Presbyopia	0	1	0	1	3	5
Cataract	0	0	0	0	1	1
Foreign body	0	1	0	1	0	2
Total	**16**	**26**	**16**	**16**	**16**	**90**

Allergic conjunctivitis was more common in participants between the ages of 24 – 29 years.

Pterygium was more common in participants of 42 years and above.

TABLE 4.8: Chi-Square Test Comparing Use of Ocular Personal Protective Equipment among Participants and Socio-Demographic Variables

	Variables	Chi-Square (*P*-Value)
Do you use any of the ocular personal protective equipment?	Age	0.539
	Gender	0.406
	Level of Education	**0.007**
If you are provided with ocular personnel protective equipment, will you use it?	Age	0.651
	Gender	0.354
	Level of Education	0.437

There was a significant relationship between the use of ocular personal protective equipment and the level of education of participants ($p < 0.05$).

CHAPTER FIVE

5.0 DISCUSSION

In this research, the prevalence of ocular morbidities among the workers of the production unit of the Coca Cola Bottling Company was studied. However, there was there was no significant correlation between areas of production of the participants and the ocular condition present in the research. In succeeding paragraphs, the outcomes of the investigation will be described.

The first section of this research comprised the socio-demographic data as shown in Table 4.1, showing the most of the participants were between the ages of 24 and 29 years with a mean of 31.3 ± 7.58 years. Majority of the workers were males, this is similar to the findings from Abraham *et al*., (2015), Ezinne *et al*., (2021), Kumah *et al*., (2017) Chaikitmongkol *et al*., (2015), Zalwango *et al*., (2021) as compared to the findings from Agrawal *et al*., (2020), Chinawa *et al*., (2020) and Ogbeanu Achigbu *et al*., (2016) were majority of their participants were females. Majority of the participants had their education at the tertiary level opposed to the results by Ay *et al*., (2022) where majority of their participants had their education at the basic education level.

Training and experience of participants in this research were also included in the second section. Table 4.2, indicated the most of the participants worked in the safety area of production and had worked for 1 to 5 years in the bottling firm. Majority of the participants indicated to work eight hours a day. This is because the workers in the production unit of the bottling company run shifts of eight hours daily.

Findings from this study (Table 4.3) showed that most of the participants are aware of behaviors which potentially cause damage. This may be because most of the participants were literates, as a majority of them seemed to have completed their tertiary level of education. This result is

however comparable to the results studies by from Osagiede *et al*., (2020), Tagurum *et al*., (2018), Ezinne *et al*., (2021), and Onyekwelu *et al*., (2019) who had greater percentages as opposed to the findings from Hassan *et al*., (2017) where the values were lower. Amongst all the activities, a substantial proportion of the participants identified packaging as a danger to eye damage, and know that the use of personal protective equipment may avoid it. The process of packaging can be concerned as a major risk to the eye in the production unit because the workers may be faced with flying glass particles from broken bottles, explosion of bottles during the process of packaging or other circumstances which may result in corneal abrasions, perforating ocular injury or any other form of ocular trauma. This result is comparable to the results by Kyriakaki *et al*., (2021). Majority of the participant obtain their information about occupational eye safety from health professionals and do not believe that they are well educated about it.

Findings from this study (Table 4.4) revealed that majority of the participants owned ocular personal protective equipment, this is similar to the findings from Tereza *et al*., (2017), Osagiede *et al*., (2020), Hassan *et al*., (2017), Praveena *et al*., (2022), as compared to the findings from Onyekwelu *et al*., (2019), where the percentage of those who own ocular personal protective equipment were lower, and a large number of them owned safety goggles, this is also similar to the findings from Osagiede *et al*., (2020) and Tagurum *et al*., (2018). Most of the participants indicated that they utilised ocular personal protection equipment in which their use was never frequently, this is comparable to the results from Ezinne *et al*., (2021), Kumah *et al*., (2017), Hassan *et al*., (2017), Hirut *et al*., (2019) and Chaikitmongkol *et al*., (2015). However, the participants were more inclined to utilize it if they were being offered. When working, most individuals contact their eyes with their hands. Their gadgets are changed generally more than 2 years and most do not undergo regular eye tests as part of their occupational health program.

Most participants do not believe that additional steps to promote eye health in the workplace are essential.

The results from Table 4.5 which presented the distribution of ocular morbidities across participants, was based on the presence of an ocular morbidity on one or both eyes of the participants. This therefore indicated that most of the participants with ocular morbidities had pterygium. Pterygium was also the most prevalent ocular morbidity in a study on brewery workers by Ukoh and Obinna (2020) and a study on auto mechanics by Kumah *et al*., (2017). Allergic conjunctivitis was the second highest followed by pinguecula, presbyopia, cornea opacity, foreign body, cataract and refractive errors. These ocular morbidities were also prevalent in studies carried out on the general population by Omoto *et al*., (2023), Chinawa *et al*., (2020), Ogbeanu Achigbu *et al*., (2016), Zalwango *et al*., (2021), Agrawal *et al*., (2020), industrial workers by Ay *et al*., (2022) and Vishwaraj *et al*., (2021), brewery workers by Ukoh and Obinna (2020), auto mechanics by Kumah *et al*., (2017), and welders by Praveena *et al*., (2022). Participants who had no ocular morbidities were 46.7% meaning that the prevalence of ocular morbidities was 53.3%, this is similar to the prevalence of ocular morbidities in studies by Adak *et al*., (2024), Zalwango *et al*., (2021) and Agrawal *et al*., (2020) who have similar percentage prevalence as compared to the study by Kumah *et al*., (2017), where all the participants had an ocular morbidity present.

Findings from the study (Table 4.6) demonstrated that there was no significant relationship between participants' ocular assessments and their areas of production ($p > 0.05$). This suggests that the ocular morbidities found among the individuals may not be as a result of the activities they carry out on their job.

Findings from this study (Table 4.7) also demonstrated that allergic conjunctivitis was more prevalent in individuals between the ages of 24 – 29 years whereas pterygium was more common in participants aged 42 years and above. The prevalence of pterygium being highest among participants aged 42 years above is not unusual as pterygium is commonly found among people in this age in the general population.

Furthermore, findings from this study (Table 4.8) demonstrated that there was a significant relationship between the usage of ocular personal protection equipment and the degree of education of participants ($p < 0.05$). Thus, it can be claimed that the usage of the ocular personal protective equipment by the participants is dependent on their level of knowledge. As stated earlier, most of the participants had completed their tertiary level of education and were highly aware of the use of ocular personal protective equipment, adding to the fact that they receive information about this from health workers.

CHAPTER SIX

6.0 CONCLUSION

In conclusion, the results from this study showed that;

Majority of the participants with ocular morbidities had Pterygium.

There was no significant relationship between patients' ocular assessment and their areas of production.

There was a significant relationship between the use of ocular personal protective equipment and the level of education of participants.

6.1 RECOMMENDATIONS

Based on this study, it is recommended to do more research in this field with a larger number of brewing companies in order to facilitate comparisons.

Caution should be used when applying these findings, given the small sample size and the fact that the data was obtained from a single brewing company.

The findings of this study indicate that while a significant proportion of the participants possess personal protective eyewear and are aware of the hazards associated with its non-usage, there remains a considerable percentage of participants who neglect to utilize it. Therefore, it is

recommended that workers in the production units receive comprehensive training on the advantages of wearing ocular protective eyewear during their work and the potential consequences of failing to do so. Additionally, it is recommended to provide workers with complimentary ocular protective eyewear throughout the sensitization process. This is based on the observation that a significant proportion of participants expressed their willingness to use personal protective eyewear if it was provided to them.

REFERENCES

Abraham, E., Megbelayin, E., & Akpan, S. (2015). Awareness and use of protective eye devices among auto mechanic technicians and auto spare parts traders in Uyo, Nigeria. *International Journal of Medical Science and Public Health*, **4(9)**, 1227-1230.

Adak, P., Ghoshal, R., & Kumar, N. (2024). Ocular morbidity trends among metal workers from an unorganized sector: A cross-sectional study. *Biomedicine*.**43(6)**:1832-1837

Agrawal, D., Sahu, A., & Agrawal, D. (2020). Prevalence of ocular morbidities among school pupils in Raipur district, India. *Indian journal of ophthalmology*, **68(2)**: 340–344.

Ahn, J. Y., Ryoo, H. W., Park, J. B., Moon, S., Cho, J. W., Park, D. H., Lee, W. K., Kim, J. H., Jin, S. C., Lee, K. W., & Kim, J. Y. (2020). Epidemiologic Characteristics of Work-related Eye Injuries and Risk Factors Associated with Severe Eye Injuries: A Registry-based Multicentre Study. *Ophthalmic epidemiology*, **27(2)**: 105–114.

AlMahmoud, T., Elkonaisi, I., Grivna, M., & Abu-Zidan, F. M. (2020). Personal protective eyewear use among industrial workers in small-scale firms. *Injury epidemiology*, **7(1)**: 54.

Avi, R. H., Hassan, M., Sial, N., Qidwai, U., Aurangzeb, Z., & Rehman, A. (2011) Wind Outcome and Pattern of Industrial Ocular Injuries. *Pakistan Journal of Ophthalmology*, **27(1)**: 801.

Ay, İ. E., Demirezen, M., Şenol, Y., & Til, A. (2022). Ocular health among industrial workers: a prevalence study of foreign body damage, refractive error, dry eye, pterygium and pingueculae. *La Medicina del lavoro*, **113(5)**: e2022044.

Azodo, C. C., & Ezeja, E. B. (2014). Ocular health practices by dental surgeons in Southern Nigeria. *BMC oral health*, **14(1)**: 115.

Bekibele, C. O., Ajayi, B. G., Baiyeroju, A. M., & Ayeni, E. A. (2003). Visual consequence of pressured bottled drinks linked eye injury in Ibadan. *African journal of medicine and medical sciences*, **32(1)**: 85–88.

Beshay, N., Keay, L., Dunn, H., Kamalden, T. A., Hoskin, A. K., & Watson, S. L. (2017). The epidemiology of Open Globe Injuries presenting to a tertiary referral eye hospital in Australia. *Injury*, **48(7):** 1348–1354.

Cataract. (n.d.). American Optometric Association. Available at: https://www.aoa.org/healthy-eyes/eye-and-vision-conditions/cataract?sso=y (Accessed: 15 March 2024).

Chaikitmongkol, V., Leeungurasatien, T., & Sengupta, S. (2015). Work-Related Eye Injuries: Important Occupational Health Problem in Northern Thailand. *Asia-Pacific journal of ophthalmology (Philadelphia, Pa.)*, **4(3)**, 155–160.

Charan, J. and Biswas. T. (2013). How to Calculate Sample Size for Different Study Designs in Medical Research. *Indian Journal of Psychological Medicine*, **35**: 121-126.

Chepkener, A.C. (2013). Knowledge, Attitude And Practice Of Eye Safety Among Jua Kali Industry Workers In Nairobi, Kenya.

Chinawa, N.E., Odogu, V., Ezeh, E.I., & Anyiam, F.E. (2020). Ocular Morbidity Pattern and Presentation among Residence of a Semi-Urban Community in Rivers State, Nigeria. *Asian Journal of Medicine and Health*, **18(8)**:14-20.

Chukwuoha C. M., Nwoke E. A., Esenwah E. C., Azuamah Y. C., & Nwaigwe O. M. (2020). Ocular Injuries among Welders in Nekede, Imo State, Nigeria. *International Journal of Health Sciences and Research*, **10(11)**: 236-240

Cochran, W.G. (1963). Sampling Technique. 2nd Edition, John Wiley and Sons Inc., New York.

Corneal Opacity Causes and Treatments | UVA Health. (n.d.). Available at: https://uvahealth.com/services/eye-care/corneal-opacity (Accessed: 15 March 2024).

Corneal Opacity | Types of Corneal Opacity | Treatment of Corneal Opacity. (n.d.). *Synergy Eye Care*. Available at: https://www.synergyeye.com/disease-corneal-opacity.html (Accessed: 15 March 2024).

Dhir. S., Detels, R., Alexander, E. (1967). The importance of environmental variables in cataract, pterygium and trachoma. *American Journal Ophthalmology*, **64**:128–135.

Eppig, T., Speck, A., Zelzer, B., & Langenbucher, A. (2014). Schutzbrille. Persönlicher Augenschutz für dem beruflichen Einsatz [Protective spectacles. Personal eye protection for professional usage]. Der Ophthalmologe : *Zeitschrift der Deutschen Ophthalmologischen Gesellschaft*, **111(7)**: 681–691.

Erdurman, F. C., Ceylan, O. M., Hürmeriç, V., Pellumbi, A., Durukan, A. H., & Sobacı, G. (2013). Ocular injuries caused by metal lids of carbonated mineral water bottles. *Turkish journal of trauma & emergency surgery*; **19(3)**: 256–260.

Ezinne, N.E., Ekemiri, K.K., & Nwanali Daniel, M.A. (2021). Occupational Ocular Injuries and Utilization of Eye Protective Devices among Sawmill Workers in the Ojo Local Government Area of Lagos State, Nigeria. *Vision*, **5(4)**:60.

Funjika, M. (2011). A study of eye injuries in adults admitted at Kenyatta national hospital eye ward, dissertation thesis for Mmed, submitted to the university of Nairobi.

Gobba, F., Dall'Olio, E., Modenese, A., De Maria, M., Campi, L., & Cavallini, G. (2017). Work-Related Eye Injuries: A Relevant Health Problem. Main Epidemiological Data from a Highly-Industrialized Area of Northern Italy. *International Journal of Environmental Research and Public Health*, **14(6)**: 604.

Hassan, S. M., Nasir, U., Anwar, U., & Talib, U. (2017). An evaluation of the degree of knowledge and reported concerns about occupational health risks and the application of personal protective gear among the welders in Lahore, Pakistan. *International Journal of Occupational and Environmental Health*, **23(2)**: 98-109.

Heath Jeffery, R. C., Dobes, J., & Chen, F. K. (2022). Eye injuries: Understanding ocular trauma. *Australian journal of general practice*, **51(7)**: 476–482.

Hirsheimer M. (2000). Soft drink bottling and canning. *Encyclopedia of Occupational Health and Safety*, **65**: 10-13.

Ibrahim, M. K. M., Wolvaardt, J. E., & Elnimeiri, M. K. M. (2021). Risk factors of ocular morbidity among under-five years old children in Khartoum State- Sudan- 2020. *Health science reports*, **4(2)**, e279.

Kimani, K., Lindfield, R., Senyonjo, L., Mwaniki, A., & Schmidt, E. (2013). Prevalence and causes of ocular morbidity in Mbeere District, Kenya. Results of a population-based survey. *Public Library of Science*, **8(8)**: 70.

Kumah, D. B., Kuutiero, I. W. N., Merepa, S. S., Bempong, B. B., Bonsu, K. A., Opare, A., & Agyei-Manu, E. (2017). Ocular Morbidity among Auto Mechanics at Suame –Magazine Area in the Kumasi Metropolis. *Mathews Journal of Ophthalmology*, **2(1)**: 014.

Kyriakaki, E. D., Symvoulakis, E. K., Chlouverakis, G., & Detorakis, E. T. (2021). Causes, occupational risk and socio-economic variables of ocular injuries: a research review. *Medicine and pharmacy reports*, **94(2)**: 131–144.

Lee, D. J., Lam, B. L., Arora, S., Arheart, K. L., McCollister, K. E., Zheng, D. D., Christ., S. L., & Davila, E. P. (2009). Reported eye care usage and health insurance status among US adults. *Arch Ophthalmol*. **127(3)**: 303–310

Mengistu, H. G., Alemu, D. S., Alimaw, Y. A., & Yibekal, B. T. (2021). Prevalence of Occupational Ocular Injury and Associated Factors Among Small-Scale Industry Workers in Gondar Town, Northwest Ethiopia, *Clinical optometry*, **13**: 167–174.

Muhammad, N., Dantani, A. M. (2014). Ocular morbidity in Sokoto State, Nigeria. *Sahel Medical Journal*, **17(3)**:91-95

Mustafa, S., Ibrahim, T., Ebru, N. C., Atakan, Y., Hayri, E., & Ozgur K. (2013). Causes and features of work-related eye injuries in western Turkey. *Indian Journal of Ophthalmology,* **61(9)**: 497–501.

Nentwig, C., Steinhoff, S., Adamec, J., & Kunz, S. N. (2021). Head/skull injury potential of empty 0.5-l beer glass bottles vs. 0.33-l Coke bottles. *International Journal of Legal Medicine*, **135(5)**, 2091–2100.

Ogbeanu Achigbu, E., Chukwuma Dike, K., Chinwe Uwakwem, A., U. Ogborogu, E., & Chinenye Nkwogu, V. (2016). Ocular Morbidity in Rural Communities in Imo State South East Nigeria. *Open Journal of Ophthalmology*, **06(03)**, 184–190.

Omoto, A., Maathai, R., & Kerochia, A. (2023). Assessment of Pattern, Distribution, and Determinants of Ocular Morbidity among Residents Seeking Care at Medical Camps in Mathare Slums, Nairobi County, Kenya. *International Journal of Tropical Disease & Health*.**44(18)**:40-64

Onyekwelu, O. M., Aribaba, O. T., Musa, K. O., Idowu, O. O., Salami, M. O., & Odiaka, Y. N. (2019). Ocular morbidity and use of protective eyewear among carpenters in Mushin local government, Lagos, Nigeria. *The Nigerian postgraduate medical journal*, **26(4)**: 199–204.

Osagiede, E., Ok, I., Ehimen, F., Airefetalor, I., Otaigbe, O., & Abah, S. (2020). Assessment of Awareness of Occupational Health Problems, and the Practices of Safety Measures among Welders in a Semi-Urban Town in South-South Nigeria. **10**.

Peate, W., F., M. (2007). Work-related ocular injuries and diseases, *American Family Physician*, **75(7)**:1017-1024.

Pedro-Egbe, C., Chibuike, S., & Nwachukwu, H. (2011). Ocular injuries from exploding glass-bottled Coca-Cola® drinks in Port Harcourt, Nigeria. *Clinical Ophthalmology*, **651**.

Pidduck, H. R., & Dillon, M. J. (2014). Management of Acute eye injuries in primary care. *InnovAiT*, **7(9)**: 526–532.

Praveena, Manoher, J. M., & Kumar, A. (2022). Prevalence and pattern of ocular disorders due to chronic exposure to arc welding among occupational welders in Western Rajasthan. *Journal of family medicine and primary care*, **11(6)**: 2620–2626.

Reidy, A., Minassian, D. C., Vafidis, G., Joseph, J., Farrow, S., Wu, J., Desai, P., & Connolly, A. (1998). Prevalence of serious eye disease and visual impairment in a north London population: population based, cross sectional study. *BMJ (Clinical research ed.)*, **316(7145)**: 1643–1646.

Refractive Errors | National Eye Institute. (2024, January 29). https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/refractive-errors (Accessed: 10 April 2024)

Schrader, W. F., & Gramer, E. (2010). Open globe injuries generated by glass bottles carrying carbonated beverages. *Graefe's archive for clinical and experimental ophthalmology*, **248(3)**: 313–317.

Senyonjo, L., Lindfield, R., Mahmoud, A., Kimani, K., Sanda, S., & Schmidt, E. (2014). Ocular morbidity and health seeking behavior in Kwara state, Nigeria: Implications for delivery of eye care services. *Public Library of Science*, **9(10)**: 104-128.

Shashikala, P., Sadiqulla, M., Shivakumar, D., & Prakash, K. H. (2013). Profile of ocular trauma at industries-related hospital. *Indian Journal of Occupational and Environmental Medicine*, **17(2)**: 66–70.

Somnath, A., & Tripathy, K. (2023). Pinguecula. In StatPearls. StatPearls Publishing.

Tagurum, Y. O., Gwomson, M. D., Yakubu, P. M., Igbita, J. A., Chingle, M. P., & Chirdan, O. O. (2018). Awareness of work dangers and application of PPE amongst welders in Jos metropolitan, Nigeria. *International Journal of Research in Medical Sciences*, **6(7)**, 2227–2233.

Tezera, S. T., Chercos, D. H., & Dessie, A. (2017). Self-reported safety procedures and related characteristics among workers of Dashen brewery share business, Gondar, Ethiopia: a cross-sectional research. *Journal of occupational medicine and toxicology*, **12**: 22.

Ukoh, C. B., & Anyatonwu O. P. (2020). Ocular Morbidities Associated with Workers in Brewing Industries. *Ophthalmology Research: An International Journal*, **13(2)**: 1-6.

Vats, S., Murthy, G. V., Chandra, M., Gupta, S. K., Vashist, P., Gogoi, M. (2008). Epidemiological study of ocular trauma in an urban slum population in Delhi, India. *Indian J Ophthalmol*;**56**:313–316.

Vishwaraj, K. M., Rudra, P. K., Saideep, D. N., Eli J. R., Pradeep, S. C., & Jagadish, A. C. (2021). A study of morbidities among electronic equipment manufacturing workers in Goa. *International Journal of Community Medicine and Public Health*, **8(8)**: 3871-3875

Wipperman J. L., & Dorsch J. N. (2013). Evaluation and treatment of corneal abrasions. *American Family Physician*, **87(2)**: 114-20.

Yoon, K. C., Mun, G. H., Kim, S. D., Kim, S. H., Kim, C. Y., Park, K. H., Park, Y. J., Baek, S. H., Song, S. J., Shin, J. P., Yang, S. W., Yu, S. Y., Lee, J. S., Lim, K. H., Park, H. J., Pyo, E. Y., Yang, J. E., Kim, Y. T., Oh, K. W., & Kang, S. W. (2011). Prevalence of eye illnesses in

South Korea: data from the Korea National Health and Nutrition Examination Survey 2008-2009. *Korean journal of ophthalmology: KJO*, **25(6)**: 421–433.

Yurt, Y. (2023). Occupational Eye Diseases. *Eurasian Journal of Medical Advances*, **3(1)**: 1–4.

Zalwango, C., Ayebare, P., Mwanja, P., Denis, E., Kasadhakawo, M., Micheal Mugerwa, M., & Ampaire, A. (2021). Prevalence and variables related with Ocular morbidity among detainees of Luzira Prison (Uganda). *BioMed Central Ophthalmology*, **21**: 278

Zhu, L., & Lou, D. (2014). Ocular injuries from compressed bottled beverages in China. *Injury*, **45(1)**: 346–347.

APPENDIX

QUESTIONNAIRE ON ASSESSMENT OF OCULAR SAFETY IN BOTTLING PLANT

Date……. Q/No. ……

PART A: Demographic data

Age: 18-23 ☐ 24-29 ☐ 30-35 ☐ 36-41 ☐ 42 and above ☐

Sex: Male ☐ Female ☐

PART B: Training and work experience.

☐ ☐ ☐ ☐

1. Level of education: Formal education Primary Secondary Tertiary
2. What area of production are you involved in? Treating water ☐ Compounding ingredients ☐ Carbonating product ☐ Filling product ☐ Packaging ☐ anitation Other,(spec ☐ _____
3. How long have you worked in this industry? Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 11 to 15 years ☐ 16 to 20 years ☐ >20 years ☐
4. How many hours do you work daily? _____

PART C: Knowledge and awareness

1. Are you aware of any activities in your daily work that pose a risk of eye injury? Yes ☐ No ☐
2. Can you name any activities you or your colleagues perform that pose a risk of eye injury? Treating water c Ca ☐ ating product C ☐ ounding ingredients Fill ☐ product Pa ☐ ging Sa ☐ ion ☐
3. Do you know how any of these injuries may be prevented? Through use of Personal protective equipment ☐ I don't know ☐ Other, (specify) _____
4. Do you wear any form of personal protective equipment for your eyes? Yes ☐ No ☐
5. Where did you first learn about occupational eye safety? Newspapers/magazines ☐ Radio ☐ Television ☐ Health workers ☐ Trainers/mentors ☐ Teachers /lecturers ☐ Other, (specify) _____
6. Do you feel well-informed about occupational eye safety? Yes ☐ No ☐

PART D: Ocular health-seeking behavior and practices

1. Do you own any form of ocular personal protective equipment? Yes ☐ No ☐ If Yes go to question 2
2. What type do you own? Safety goggles ☐ Face shield ☐ Safety spectacle with side shield ☐ Safety spectacle ☐ Other (specify)_____
3. Do you use any of the ocular personal protective equipment? Yes ☐ No ☐
4. If yes, how often do you use it? Always ☐ Sometimes ☐ Never ☐
5. Do you rub your eyes with your hands while working? Yes ☐ No ☐

☐ ☐ ☐

6. How regularly are your devices replaced? < 6 months. 1-2years. > 2years. Other _____
7. If you are provided with an ocular personnel protective equipment will you use it? Yes ☐ No ☐
8. Do you receive regular eye examinations as part of your occupational health program? Yes ☐ No ☐ If yes, how often? _____
9. Are there any additional protective measures you think should be implemented to improve ocular health in the workplace? _____

OCULAR ASSESSMENT FORM

AGE:

VISUAL ACUITY

	Unaided		**Aided**	
	@6M	**@4M**	**@6M**	**@4M**
OD				
OS				
OU				

PENLIGHT EXAMINATION

General appearance	OD	OS
Lids and margins		
Conjunctiva		
Cornea		
Iris		
AC angle		
Pupil		

OPHTHALMOSCOPIC EXAMINATION

	OD	OS
Lens		
Vitreous		
C/D ratio		
Caliber ratio		
Macular Area		
Fovea reflex		
Periphery		

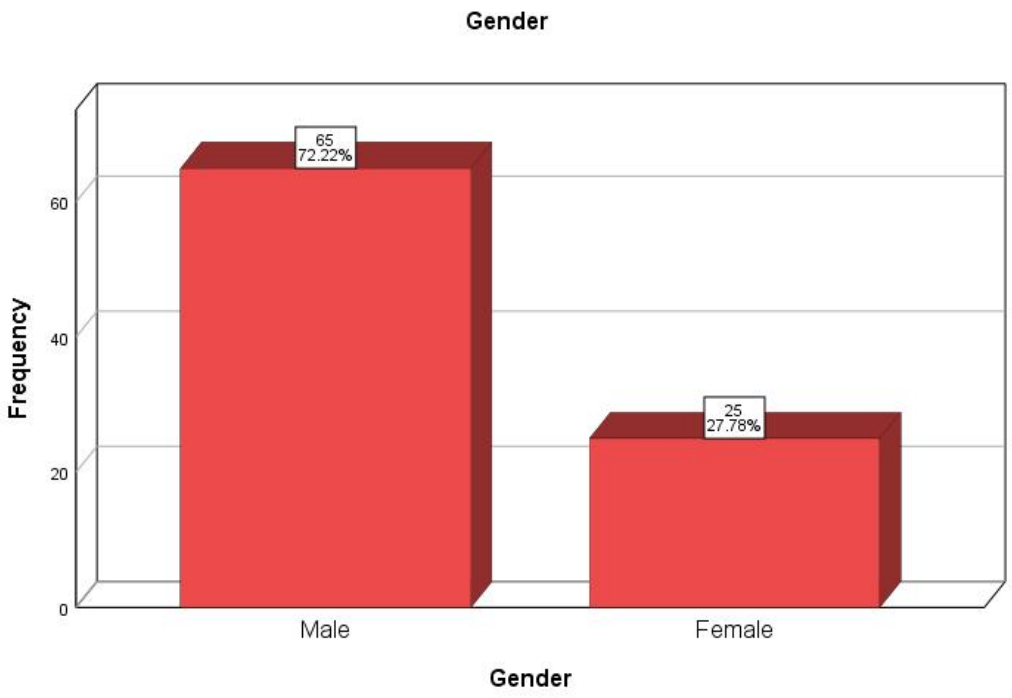
REMARKS:_____

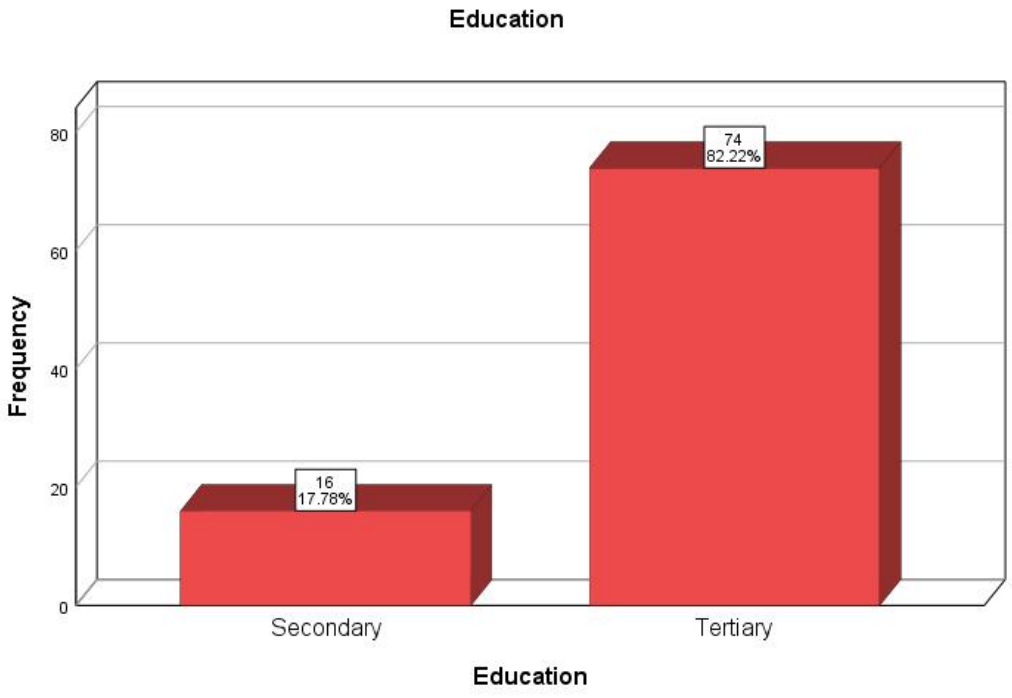
_____

_____

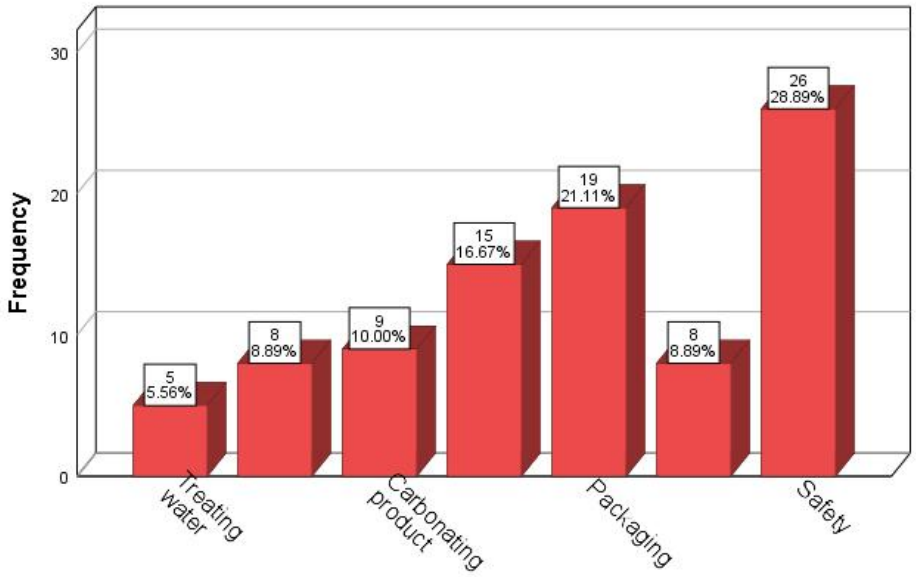
_____

_____

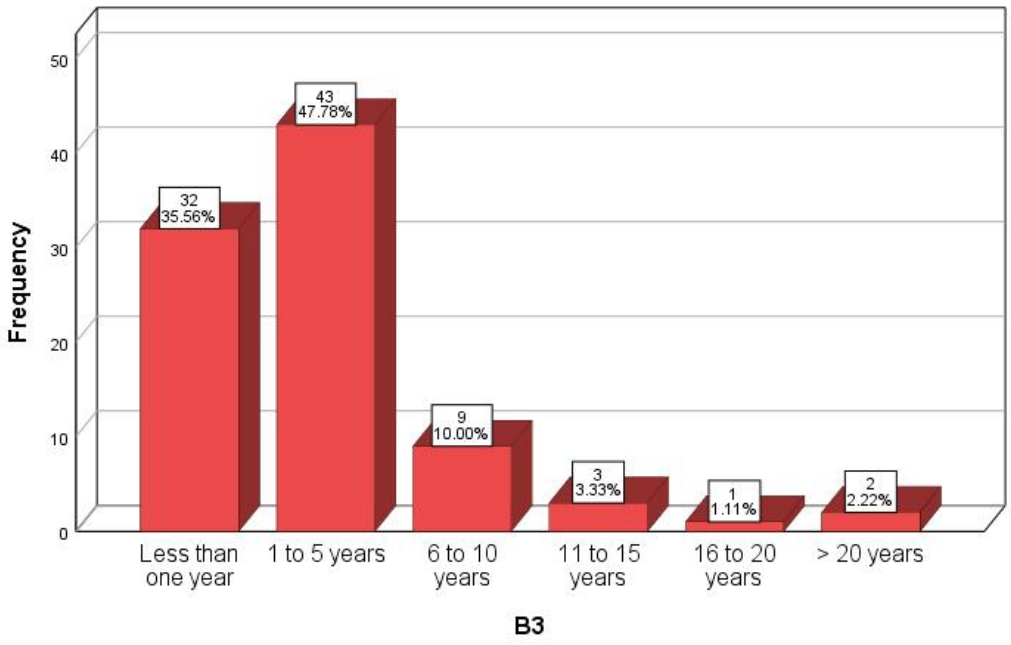

Gender
65
72.22%
25
27.78%
60
40
20
0
Frequency
Male
Female
Gender


Education
74
82.22%
16
17.78%
80
60
40
20
0
Frequency
Secondary
Tertiary
Education

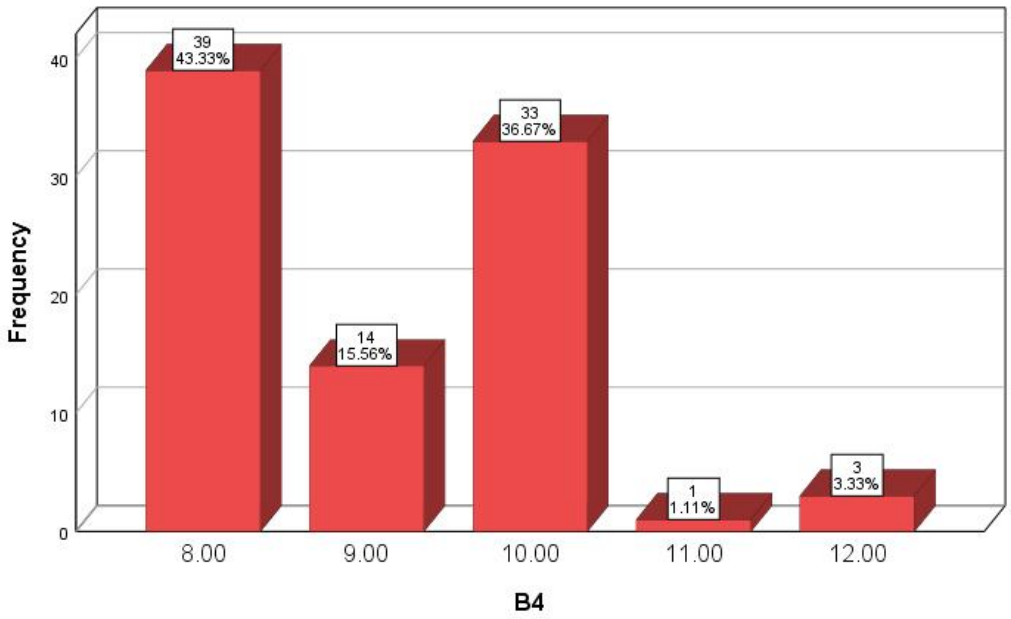
B2


Frequency
30
20
10
0
5
5.56%
8
8.89%
9
10.00%
15
16.67%
19
21.11%
8
8.89%
26
28.89%
Treating water
Carbonating product
Packaging
Safety

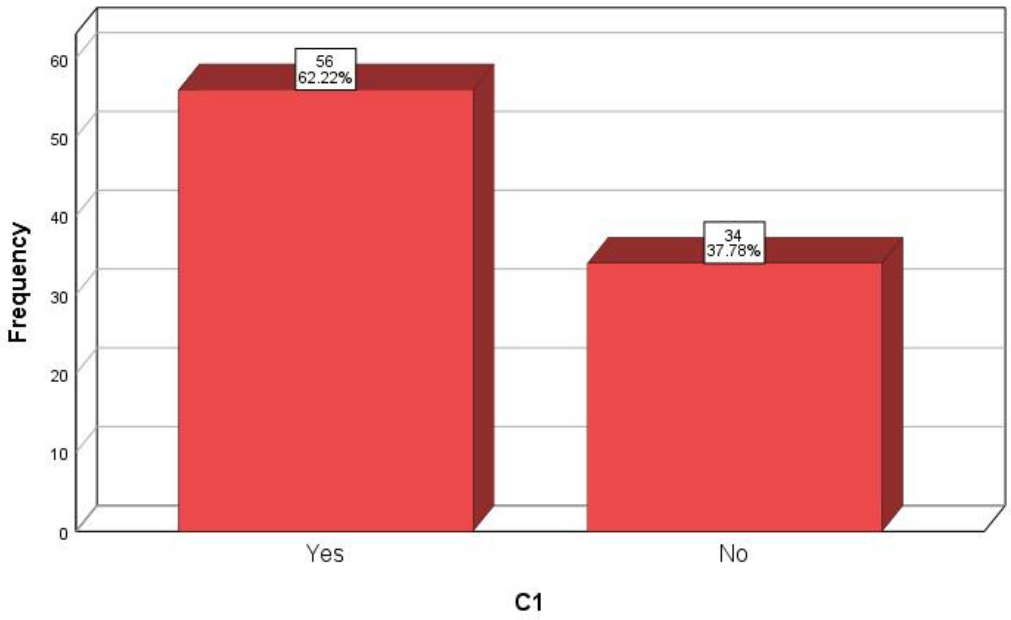
B3


Frequency
50
40
30
20
10
0
32
35.56%
43
47.78%
9
10.00%
3
3.33%
1
1.11%
2
2.22%
Less than one year
1 to 5 years
6 to 10 years
11 to 15 years
16 to 20 years
> 20 years
B3

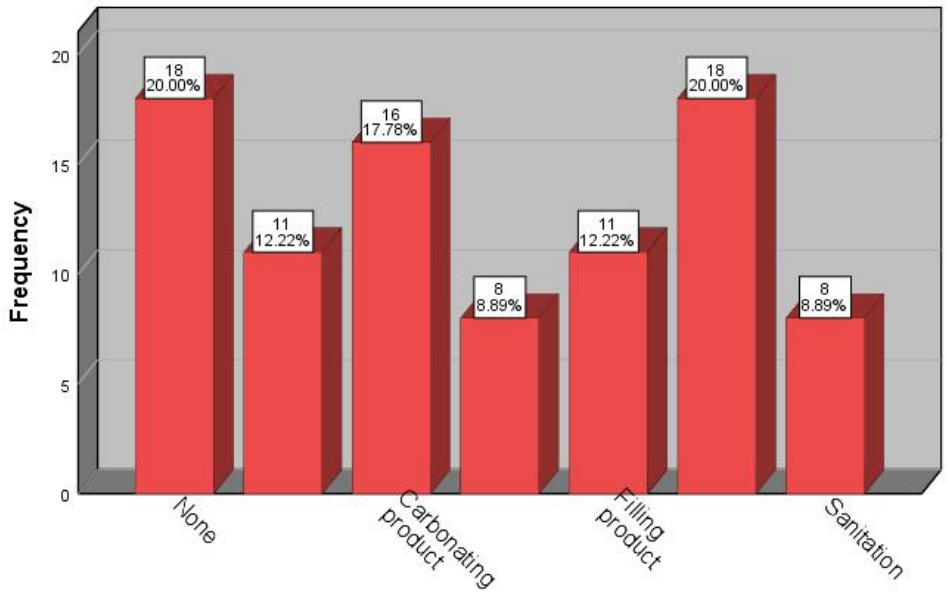
B4


Frequency
40
30
20
10
0
39
43.33%
14
15.56%
33
36.67%
1
1.11%
3
3.33%
8.00
9.00
10.00
11.00
12.00
B4

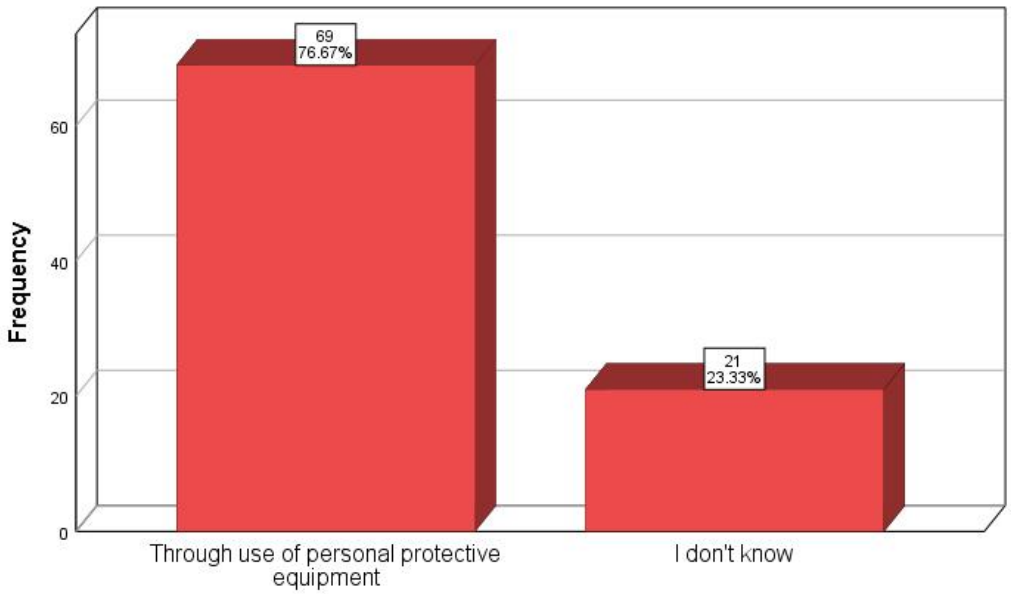
C1


Frequency
60
50
40
30
20
10
0
56
62.22%
34
37.78%
Yes
No
C1

C2

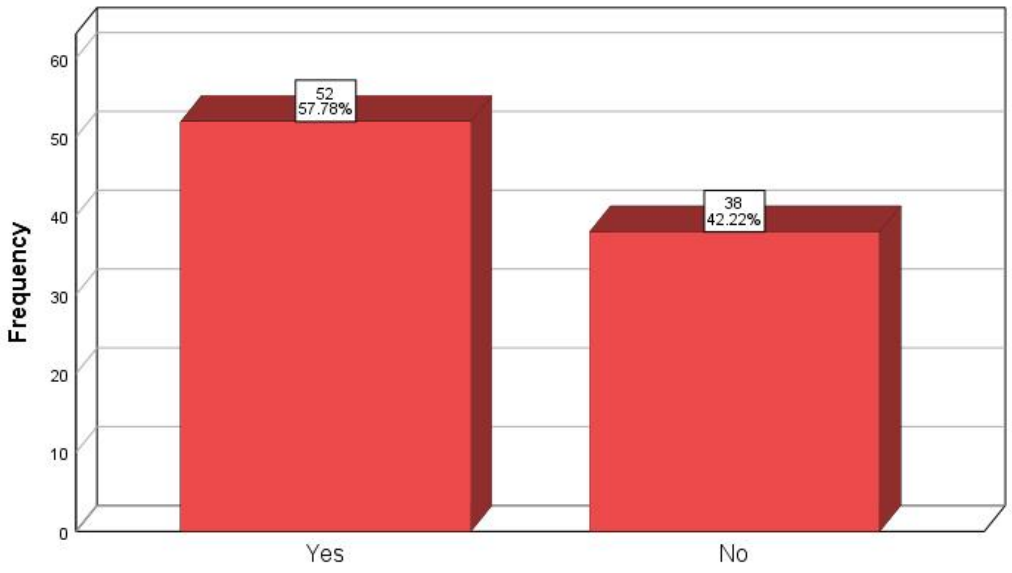

Frequency
20
15
10
5
0
18
20.00%
11
12.22%
16
17.78%
8
8.89%
11
12.22%
18
20.00%
8
8.89%
None
Carbonating product
Filling product
Sanitation

C3


Frequency
60
40
20
0
69
76.67%
21
23.33%
Through use of personal protective equipment
I don't know

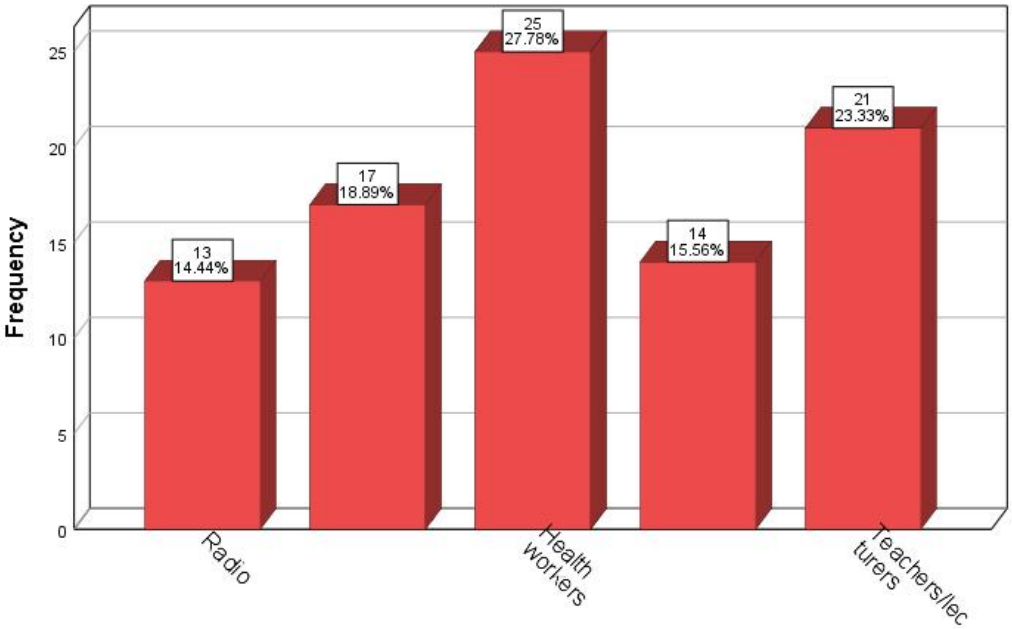
C3

C4

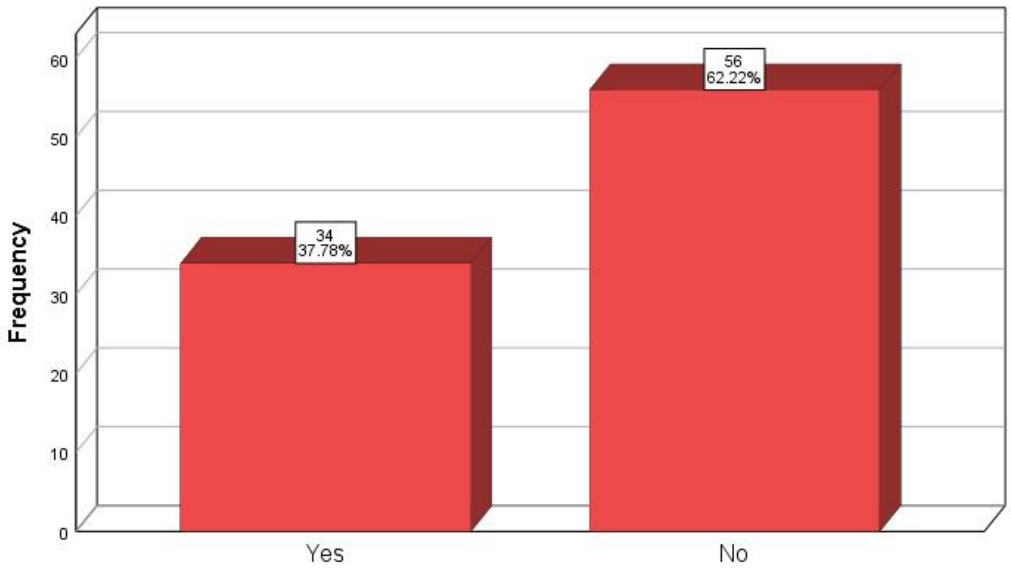

Frequency
60
50
40
30
20
10
0
52
57.78%
38
42.22%
Yes
No

C4

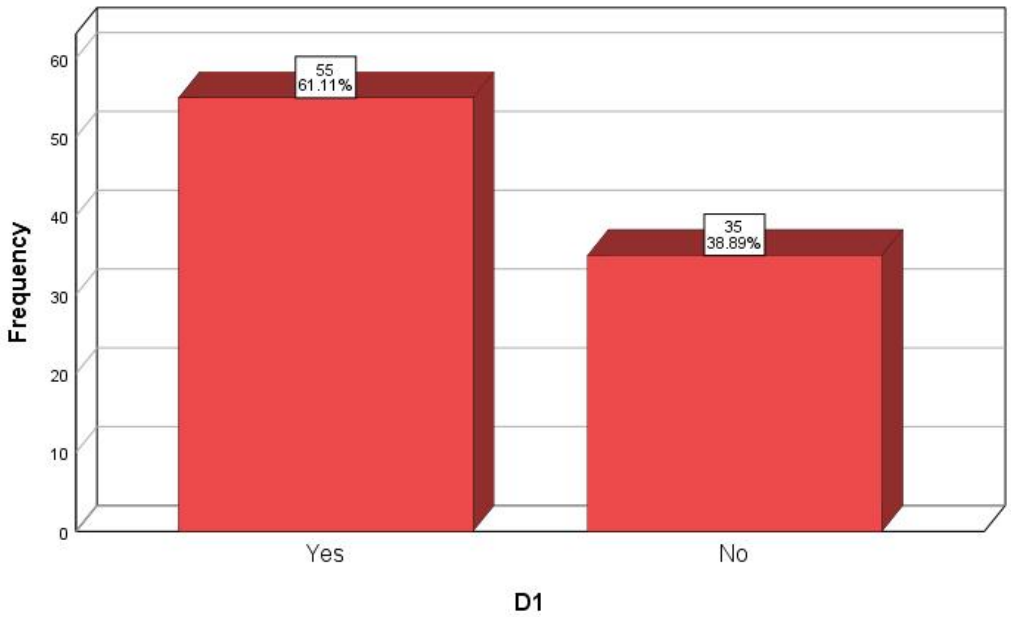
C5


Frequency
25
20
15
10
5
0
13
14.44%
17
18.89%
25
27.78%
14
15.56%
21
23.33%
Radio
Health workers
Teachers/lecturers

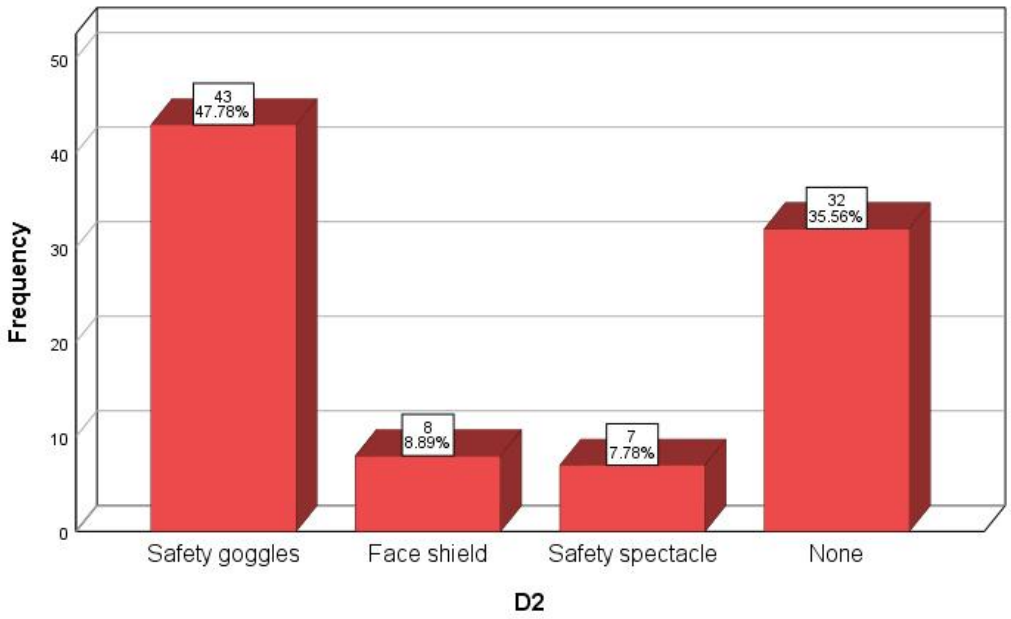
C6


Frequency
60
50
40
30
20
10
0
56
62.22%
34
37.78%
Yes
No
C6

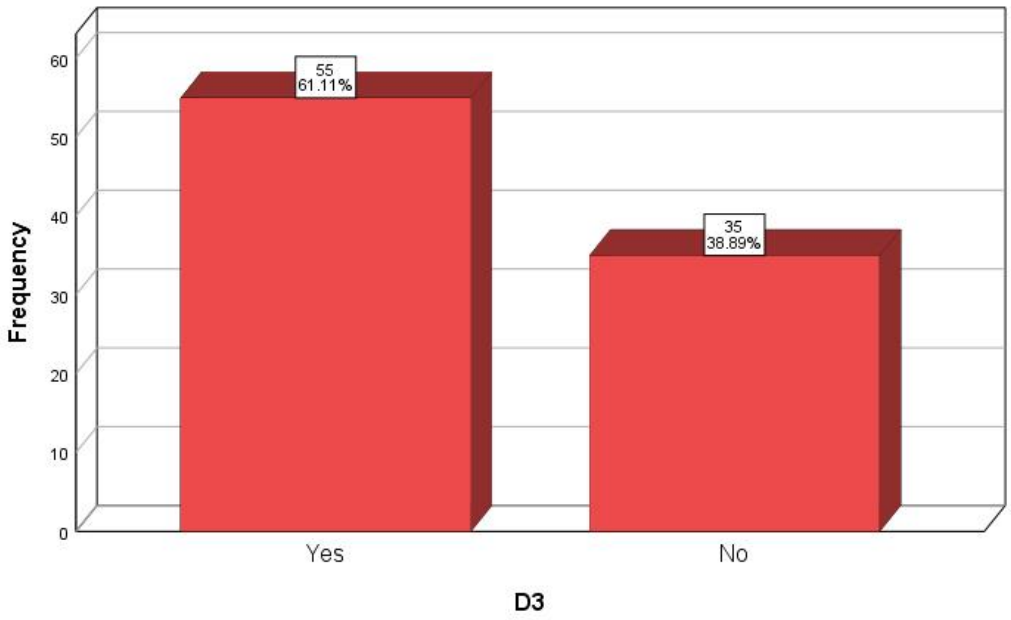
D1


Frequency
60
50
40
30
20
10
0
55
61.11%
35
38.89%
Yes
No
D1

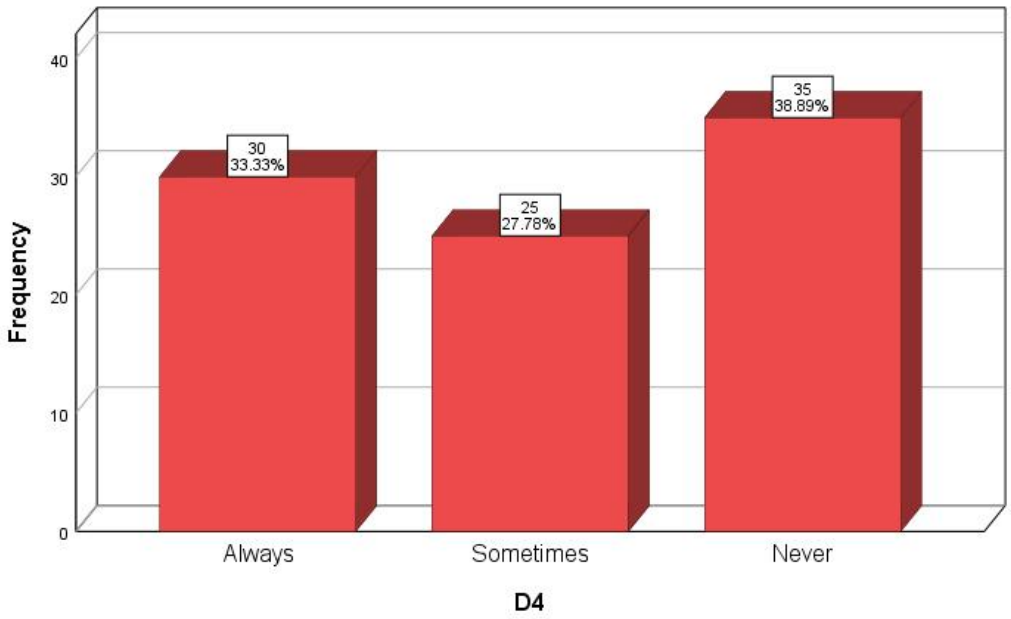
D2


Frequency
50
40
30
20
10
0
43
47.78%
8
8.89%
7
7.78%
32
35.56%
Safety goggles
Face shield
Safety spectacle
None
D2

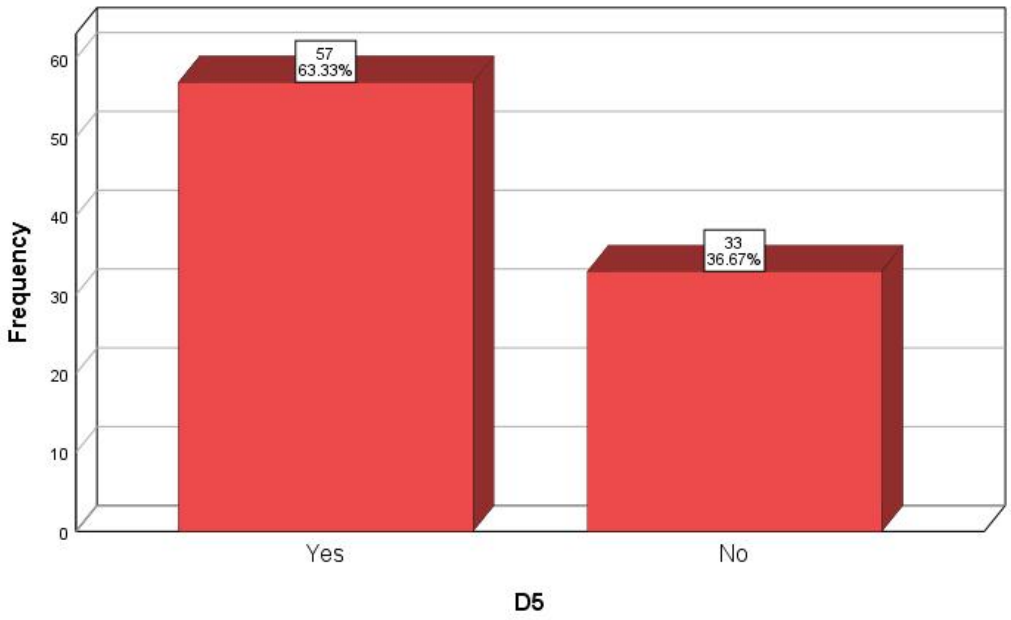
D3


Frequency
60
50
40
30
20
10
0
55
61.11%
35
38.89%
Yes
No
D3

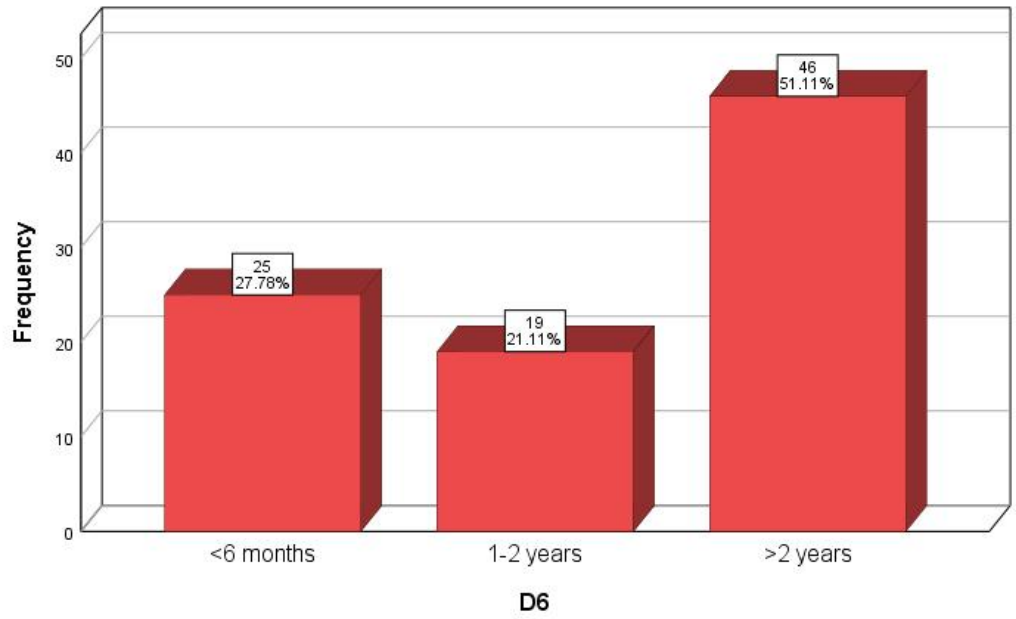
D4


Frequency
40
30
20
10
0
30
33.33%
25
27.78%
35
38.89%
Always
Sometimes
Never
D4

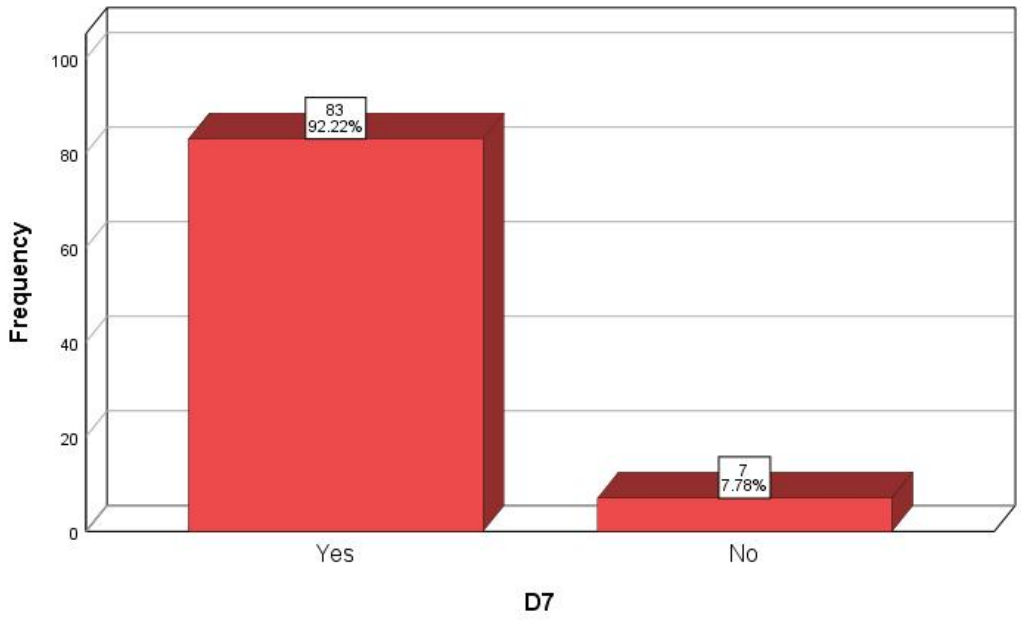
D5


Frequency
60
50
40
30
20
10
0
57
63.33%
33
36.67%
Yes
No
D5

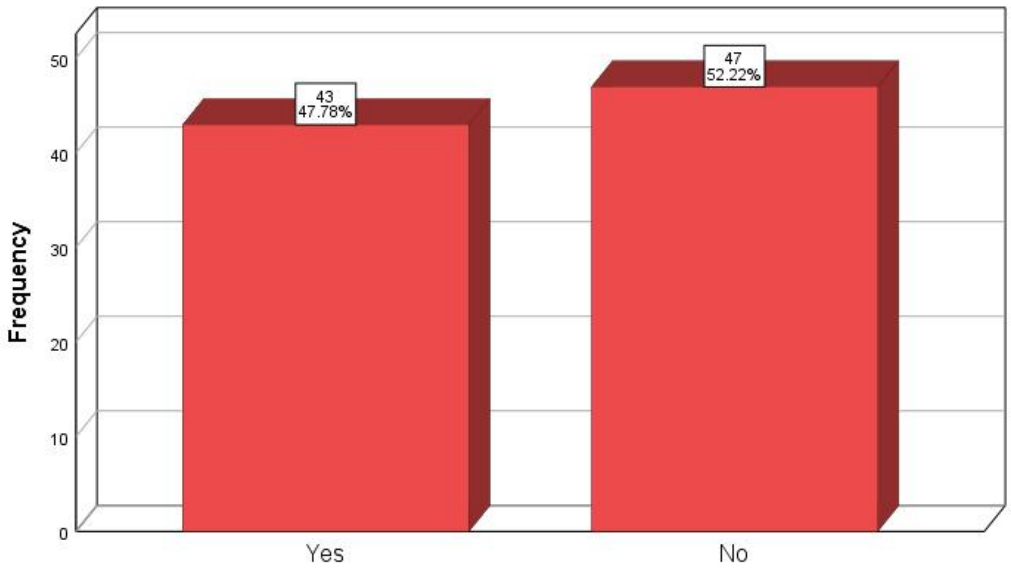
D6


Frequency
50
40
30
20
10
0
25
27.78%
19
21.11%
46
51.11%
<6 months
1-2 years
>2 years
D6

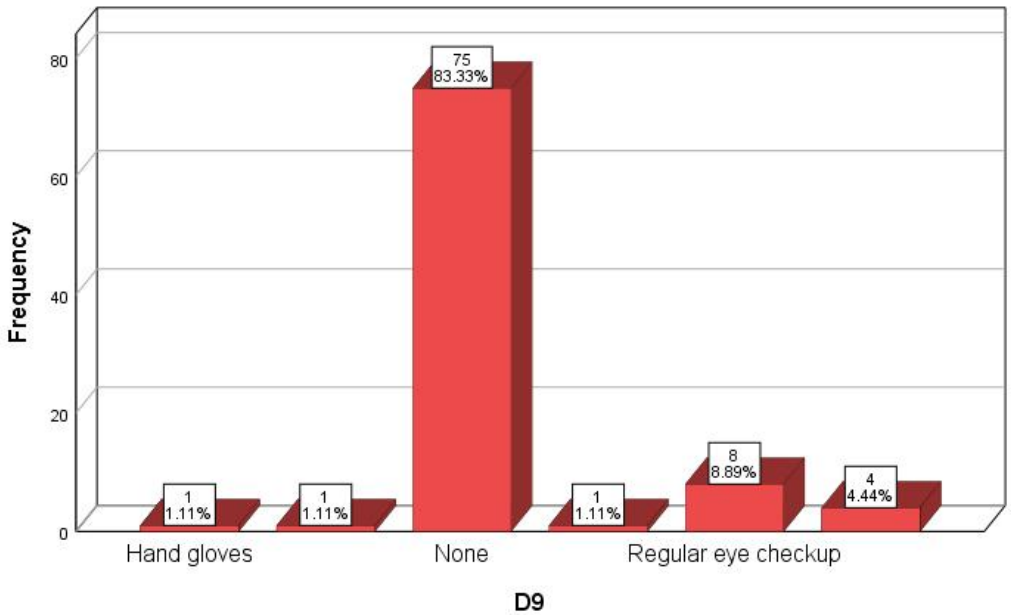
D7

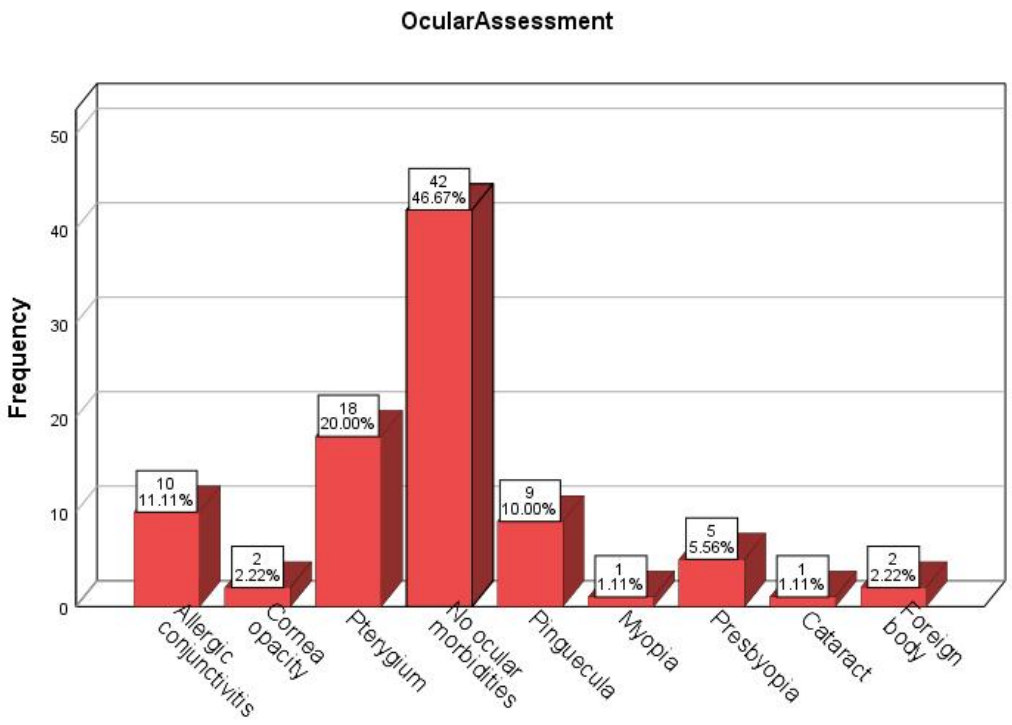

Frequency
100
80
60
40
20
0
83
92.22%
7
7.78%
Yes
No
D7

D8


Frequency
50
40
30
20
10
0
43
47.78%
47
52.22%
Yes
No
D8

D9


Frequency
80
60
40
20
0
1
1.11%
1
1.11%
75
83.33%
1
1.11%
8
8.89%
4
4.44%
Hand gloves
None
Regular eye checkup
D9



Crosstab

Count

		Age					
		18-23	24-29	30-35	36-41	42 and above	Total
D3	Yes	12	14	8	11	10	55
	No	4	12	8	5	6	35
Total		16	26	16	16	16	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.113[a]	4	0.539
Likelihood Ratio	3.175	4	0.529
Linear-by-Linear Association	0.019	1	0.889
N of Valid Cases	90		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.22.

Crosstab

Count

		Gender		
		Male	Female	Total
D3	Yes	38	17	55
	No	27	8	35
Total		65	25	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.691[a]	1	0.406		
Continuity Correction[b]	0.348	1	0.555		
Likelihood Ratio	0.703	1	0.402		
Fisher's Exact Test				0.475	0.280
Linear-by-Linear Association	0.684	1	0.408		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.72.

b. Computed only for a 2x2 table

Crosstab

Count

		Education		
		Secondary	Tertiary	Total
D3	Yes	5	50	55
	No	11	24	35
Total		16	74	90

Chi-Square Tests

	Value	df	Asymptotic	Exact Sig. (2-	Exact Sig. (1-

			Significance (2-sided)	sided)	sided)
Pearson Chi-Square	7.301[a]	1	0.007		
Continuity Correction[b]	5.853	1	0.016		
Likelihood Ratio	7.157	1	0.007		
Fisher's Exact Test				0.010	0.008
Linear-by-Linear Association	7.220	1	0.007		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.22.
b. Computed only for a 2x2 table

Crosstab

Count

		Age					
		18-23	24-29	30-35	36-41	42 and above	Total
D7	Yes	15	23	14	15	16	83
	No	1	3	2	1	0	7
Total		16	26	16	16	16	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.464[a]	4	0.651
Likelihood Ratio	3.580	4	0.466
Linear-by-Linear Association	0.848	1	0.357
N of Valid Cases	90		

a. 5 cells (50.0%) have expected count less than 5. The minimum expected count is 1.24.

Crosstab

Count

		Gender		
		Male	Female	Total
D7	Yes	61	22	83
	No	4	3	7
Total		65	25	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.860[a]	1	0.354		
Continuity Correction[b]	0.238	1	0.625		
Likelihood Ratio	0.796	1	0.372		
Fisher's Exact Test				0.392	0.299
Linear-by-Linear Association	0.851	1	0.356		
N of Valid Cases	90				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.94.

b. Computed only for a 2x2 table

Crosstab

Count

		Education		
		Secondary	Tertiary	Total
D7	Yes	14	69	83
	No	2	5	7
Total		16	74	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.605[a]	1	0.437		
Continuity Correction[b]	0.069	1	0.792		
Likelihood Ratio	0.538	1	0.463		
Fisher's Exact Test				0.603	0.362
Linear-by-Linear Association	0.598	1	0.439		
N of Valid Cases	90				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.24.
b. Computed only for a 2x2 table

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	55.480[a]	48	0.214
Likelihood Ratio	52.810	48	0.294
Linear-by-Linear Association	0.103	1	0.748
N of Valid Cases	90		

a. 59 cells (93.7%) have expected count less than 5. The minimum expected count is 0.06.