THESIS

KNOWLEDGE, ATTITUDE AND PRACTICE OF EYE SAFETY AMONG JUA KALI INDUSTRY WORKERS IN NAIROBI, KENYA.

Dr Alexandria C Chepkener

A thesis presented in partial fulfilment of the requirements for the Degree of Masters in Medicine (Ophthalmology), Faculty of Medicine, Department of Ophthalmology, University of Nairobi.
DECLARATION.

I declare that this is my original work and that it has never been published or presented for a degree in any other university.

PRIMARY INVESTIGATOR
DR ALEXANDRIA C. MASHEP
REGISTRATION NUMBER H58/65538/10
MBChB

SIGNATURE.......................... DATE...13/9/2013...

SUPERVISORS:
PROF. DUNERA ILAKO
MBChB, M.MED (OPHTHALMOLOGY), MBA-HEALTH, FEACO
ASSOCIATE PROFESSOR OF OPHTHALMOLOGY, DEPARTMENT OF OPHTHALMOLOGY
UNIVERSITY OF NAIROBI

SIGNATURE.................................. DATE...23/9/2013...

DR SHEILA MARCO
MBChB, MMED (OPHTHALMOLOGY), FEACO
LECTURER, GLAUCOMA SPECIALIST
UNIVERSITY OF NAIROBI

SIGNATURE.......................... DATE...20/9/2013...
DEDICATION.

I dedicate this work to my beloved husband Kipkurui, and to our children Cherotich and Kimutai Mashep.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ARMD</td>
<td>Age-related macular degeneration</td>
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<tr>
<td>BETTS</td>
<td>Birmingham Eye Trauma Terminology System</td>
</tr>
<tr>
<td>DIY</td>
<td>Do-it-yourself</td>
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<tr>
<td>FGD</td>
<td>Focus group discussion</td>
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<tr>
<td>GDP</td>
<td>Gross domestic product</td>
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<tr>
<td>ILO</td>
<td>International labour organization</td>
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<tr>
<td>KII</td>
<td>Key informant interview</td>
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<tr>
<td>KNJKA</td>
<td>Kamukunji national Jua Kali association</td>
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<tr>
<td>KNH</td>
<td>Kenyatta National Hospital</td>
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<tr>
<td>OR</td>
<td>Odds ratio</td>
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<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
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<tr>
<td>RBA</td>
<td>Retirement benefits authority</td>
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<tr>
<td>SME</td>
<td>Small and micro-enterprise</td>
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ABSTRACT.

Title: A study on the knowledge, attitude and practice of eye safety among Jua Kali industry workers in Nairobi, Kenya.

Purpose: To describe the knowledge, the patterns of personal protective equipment use and of health seeking behaviour in the event of work-related eye injury, and attitudes towards eye safety.

Study methodology: This was a cross-sectional descriptive study that involved interviews and nonparticipant observations for quantitative data, and focus group discussions and key informant interviews for qualitative data. 68 participants from two high risk Jua Kali groups: mechanics in “Grogon” and metal workers in Kamukunji, Gikomba were sampled for the interviews and observations. Convenient sampling was used to select the starting point for the interviews and observations, and thereafter, purposive sampling was used to include workers performing the range of activities at the sites. Two focus group discussions and three key informant interviews were conducted and audio-recorded after the interviews and observations were completed and analysed, using interview guides, in the presence of a moderator. Qualitative data was analysed using Nvivo QSR, and quantitative data was analysed using Stata version 10, with statistical tests performed at a 5% statistical significance level.

Findings: Majority of the participants(86.8%) had knowledge on the risks and mechanisms of work-related eye injuries, and 73% had knowledge that these can be prevented through the use of personal protective equipment (PPE). There was a low rate of observed PPE use (11.8%), with a statistically significant correlation of PPE use with level of education and formal training (p value <0.001) as compared to apprenticeship. The main reasons for the observed poor PPE compliance were ignorance of the threat of eye injury, unavailability and unaffordability of PPE, competing priorities, poor visibility and reduced dexterity while using PPE, and the lack of mentor/supervisor influence. There was a 30.9% prevalence of work-related eye injury, mostly from metallic projectiles and radiation exposure, but majority of the workers did not seek medical attention after sustaining eye injury. The main reasons for delayed or failure to seek medical attention in the event of eye injury were the perception that the injury was minor, relief from temporizing measures, lack of money, competing priorities and the cost implications of work opportunities lost while seeking medical attention.

Conclusions: There is a high level of awareness of the risk of work-related eye injury and of how these can be prevented. There is poor compliance to PPE use, and a poor attitude towards occupational eye safety. The poor attitude may be the gap between the high levels of awareness and the low levels of practice, and this needs to be addressed using a multicomponent behavioural approach.
1. INTRODUCTION.

1.1 Introduction to eye trauma.

Eye trauma refers to any injury to the eye\(^1\), the entire globe being used as the tissue of reference, and may occur by one or a combination of multiple mechanisms. The Birmingham Eye Trauma Terminology System (BETTS)\(^2\) broadly classifies ocular injuries into two categories: closed globe injuries, which include contusions and lamellar lacerations, and open globe injuries, which include globe rupture, penetrating injuries, intraocular foreign bodies and perforations.

1.2 The burden of ocular trauma.

Ocular trauma is an important and mostly preventable public health concern worldwide. According to the World Health Organization (WHO) data bank\(^3,4\), 1.6 million people are blind from ocular injuries, 2.3 million have post-traumatic bilateral visual impairment and 19 million suffer unilateral visual impairment or blindness. 5 million blinding ocular injuries occur annually, i.e. 13,698 daily. 55 million ocular injuries that restrict at least one day of activity occur annually, i.e. 150,684 daily, 750,000 of which require hospitalization, including 200,000 open globe injuries. Ocular trauma has been identified as the commonest cause of unilateral visual loss, accounting for 40% of monocular blindness\(^3,4\).

The incidence of ocular trauma is significantly higher in developing countries\(^3,4\). 1.5 million of the 1.6 million injuries reported globally (94%) occur in developing countries, as do 15.3 million cases of monocular blindness. Prevalence estimates of blindness due to ocular injuries occur in 0 to 75 per 100,000 persons in developing countries, and unilateral visual impairment occurs in 0 to 490 per 100,000 persons compared to 9 per 100,000 persons for blindness, and 300 per 100,000 persons with unilateral visual impairment in developed countries. The Baltimore Eye Survey\(^5\) found that the prevalence of visual impairment and blindness following ocular trauma was highest among black males, being three times that among white males, followed by that among black females and was least among white females.

According to the Baltimore Eye Survey\(^5\), the lifetime prevalence of ocular trauma was 22.5% among black males, comparable to 20.5% among white males but the visual outcomes were significantly worse among black males. The lifetime prevalence of visual impairment and blindness resulting from ocular trauma is significantly higher than that secondary to glaucoma, age-related macular oedema (ARMD) or diabetic retinopathy. The lifetime prevalence of glaucoma-related visual impairment
is 4.6%, and glaucoma-related blindness is 6.1%, while the lifetime prevalence of vision-threatening diabetic retinopathy is 6.6%, and 14.2% for ARMD.

1.3 The socioeconomic costs of ocular trauma.

The burden of ocular trauma and morbidity has important socioeconomic implications. The group identified as most likely to suffer ocular trauma is young males in the age group of 21 to 30 years. This is a productive age group, while males are considered to predominantly be the breadwinners. It therefore has significant negative impact on personal as well as societal productivity. A review of eye injuries in adults hospitalized in Kenya’s Kenyatta national hospital (KNH), the largest referral hospital serving East and Central Africa, revealed that majority of the patients admitted were in this age group and that the ratio of males to females was 7.2 to 1.

Severe ocular injuries require expensive hospitalization, specialist treatment, prolonged follow up and rehabilitation. The study done at KNH showed that 90.6% of the patients had open globe injuries requiring surgery under general anaesthesia; the average duration of hospitalization was 11.9 days; and the median cost of hospitalization was Ksh 9552.50. 14.3% of the patients were unable to clear their cumulative bill of Ksh 362,995 which was waived by the hospital, and 7% absconded from the hospital several days after being discharged, costing the hospital a further Ksh 171,945. The study also revealed that majority of the patients (46.4%) first presented to a medical facility more than 24 hours after the injury and only 47.9% came for the first review after being discharged. It is important to point out that the KNH is a government-supported facility and the financial costs mentioned are significantly subsidized.

Studies have also shown that more than 90% of work-related injuries are preventable by the adoption of safety measures and the use of personal protective equipment. This therefore implies that the cost of treating ocular injuries, through hospital admissions, surgeries and medications; work hours lost during such treatment; the greater likelihood of recurrence of ocular injury, and loss of family income, may all be avoidable and unnecessary.

1.4 Settings of ocular injuries

Globally, work-related ocular injuries are the most common but the mechanisms and patterns of injury may vary geographically with each regions’ predominant economic activities. Industry-related injuries occur more commonly in developed countries while agricultural and an increasing proportion of industry-related injuries occur in developing countries. In Kenya, majority of ocular injuries occurred in rural areas, in the context of farming but from the mid-1980s, with the growth of
the informal sector, industry-related injuries have constantly been on the increase. Work-related injuries are responsible for 22 to 50% of total ocular trauma in the USA, 42% in Australia and 70% in the United Kingdom.8

The home environment is the second commonest setting of ocular trauma, accounting for 15 to 41% global statistics. In some countries such as Canada, most injuries (67%) occur at home.8 Blunt trauma, small foreign body entry and the use of hand tools such as hammers and drills used for home repairs and do-it-yourself (DIY) projects are implicated. A study in Malawi found that more than 50% of patients admitted with serious ocular injuries sustained injuries in the domestic environment, commonly by wood splinters from chopping fire wood.22

Sports and recreation activities may cause by blunt trauma from sporting equipment such as racquets, velocity injuries from balls, accidental field injuries, or direct trauma from high contact sports such as boxing and rugby. Children are also likely to suffer injury from pellet and air guns, playing with catapults and slings, or from the inappropriate or otherwise unsupervised handling of fireworks.

Eye injuries from assault typically occur in young males of lower socioeconomic status in urban settings. A study reviewing the epidemiology of serious ocular trauma in Egypt revealed that assault was the commonest cause of ocular trauma.7 Travel and war-associated trauma from penetrating injuries or intraocular foreign bodies account for 5 to 31% of total ocular injuries worldwide.8

1.5 Factors generally predisposing to ocular trauma.

Age is a well known risk factor that has a bimodal distribution. The first peak occurs in the 21 to 30 years age group,8,9,13,18, and is predominantly in males8. A second peak occurs after 70 years where the incidence of injury in females is three times that in the first peak. One explanation for higher incidence of work-related injuries in the young is that they may be unskilled or inexperienced. However, one study found that the incidence of work-related ocular injury was more than 4 times higher among those with greater than 5 years of experience than it was in those who were new to the industry or department.14

Males are seven times more likely to suffer ocular injuries as females.8,9,13,18. The higher incidence and prevalence of ocular trauma among males is manifest as early as in mid-childhood.16 It is thought that females are less likely to be involved in activities or occupations which bear higher risks of ocular injury, or if involved may generally be more cautious. Young males may be at an additionally increased risk from being more adventurous, less cautious, under the influence of alcohol or drugs, and more likely to be involved in fights.7
A history of ocular trauma is associated with an increased risk of recurrence in the next five years, the adjusted odds ratio (OR) being 3.27 for monocular trauma and 5.5 for bilateral trauma, as shown in the Beaver Dam Eye Study\textsuperscript{6}. Overworking and chronic fatigue, poor general health, systemic medications and the use of substances of abuse all increase risk of ocular injury.

Low socioeconomic status has been associated with increased risk of ocular injury\textsuperscript{8}, probably because it is in turn associated with low levels of education and literacy. Individuals may not perceive the threat of ocular injury, may be involved in occupations with high risk of ocular injury, may not promptly seek medical help in the event of injury, may be unable to read instructions on use of products or warnings, and are more susceptible to severe injuries from assault.

1.6 Factors predisposing to work-related ocular trauma

Certain occupations have been associated with higher risk. Construction, metal workers and automotive industry workers have been identified as significant at-risk groups\textsuperscript{9,11,13,15}. These groups of workers have been found to have the highest frequency of penetrating eye injuries, and are also the least likely to wear personal protective equipment (PPE)\textsuperscript{15}. These groups are involved in the use of machinery or activities that generate dusts and/or flying particles that may cause open globe injuries, thermal burns and chemical injuries. Activities such as hammering, grinding, arc welding\textsuperscript{21}, sanding, soldering and smelting are implicated. The handling of chemicals such as acids and solvents poses risk of chemical injury while activities such as arc welding and smelting pose risk of thermal injury. Other injuries such as occur in ultraviolet, infrared and radiant light exposure during arc welding and soldering may be subtle and yet cause profound impairment on chronic exposure. Overhead work poses risk of falling objects and sparks which may injure the eye, more so in garage mechanics who may do repair work involving welding and soldering under vehicles without appropriate work surfaces and where visibility may also be poor. It should also be noted that injury in these groups is not only to the individual engaged in the hazardous activity but may also affect observers such as colleagues, supervisors and innocent bystanders. Often, injury may occur from a combination of multiple mechanisms, for example, thermal, chemical and mechanical injury following the explosion of a car battery.

While majority of work-related injuries are preventable, absent, inadequate or inappropriate use of personal protective equipment (PPE) remains an important risk factor\textsuperscript{8,10,12,14,19}. PPE is defined as all the equipment intended to be worn or held by a person at work to protect him or her from risks to his/her health and safety, and these include safety helmets, eye protection devices, gloves, high visibility clothing, safety footwear and safety harness. Protective eye wear includes spectacles, goggles, face shields and visors, and must be suitable for the task at hand. PPE users must be trained in why and when
to use PPE, to repair or replace damaged PPE, and be reminded continually to appropriately and consistently use it\textsuperscript{20}.

The gross negligence in the use of safety eye wear has been reported globally and remains a continuing concern. A prospective study in Avarind Eye hospital showed that 87.7\% of patients seen with ocular injury were not wearing any safety eye wear at time of injury\textsuperscript{14}. It is not enough to wear some eye safety, it must be the right wear. The right eye protection for each work situation depends upon the type of work and its inherent hazards, the circumstances of exposure, other protective equipment used and the individual’s vision needs. Those with refractive errors should have prescription safety lenses or a shield to cover their regular refractive correction. Ideally, the safety wear should be custom made and fitted by professionals for the specific job.

Other risk factors that have been identified are performance of unfamiliar tasks (OR 57.0), operation of faulty tools or pieces of equipment (OR 48.5), distraction while working (OR 24.0), being rushed (OR 13.0), fatigue (OR 10.0), and poor work environment (OR 4.3)\textsuperscript{33}.

1.7. Personal protective equipment (PPE) compliance

This is a great concern globally and several studies\textsuperscript{12,19,23,24} have sought to answer why PPE compliance remains low, even in settings where PPE is available, and the use and benefits of PPE are known\textsuperscript{23,25}. The reasons for this in order of importance or most frequently cited are discomfort while using PPE; fogging; individuals had no knowledge of hazard/did not think it was necessary for the task; perceived reduced risk if the task is brief; PPE not easily accessible from site of work task; lack of coworker/supervisor influence; too hot; poor fit; unattractive looking, and unavailability of PPE\textsuperscript{20,25}.

Majority of these studies were done in developed countries where unavailability of PPE may not have been a major factor. The few studies done in developing countries show that lack of knowledge and unavailability of PPE were the commonest reasons for poor compliance\textsuperscript{14}. The study in Avarind Eye Hospital revealed that 67.7\% of the patients were not aware of possibility of eye injury, and 76.9\% reported that PPE was not available. Still, of those who had PPE, only 14\% wore it regularly\textsuperscript{14}.

Several studies done in Africa, particularly in Nigeria among Industrial welders, have shown that workers generally have a high level of awareness of the threat of ocular injury, as high as 98 percent awareness, but this did not translate to the practice of eye safety, even when PPE was provided\textsuperscript{32,33}.
2. INTRODUCTION TO THE JUA KALI INDUSTRY.

2.1 Defining the informal sector and the Jua Kali industry

The concept of informal sector was introduced into international usage in 1972 by the International Labour Organization (ILO) in its Kenya Mission report which defined informality as “a way of doing things”, characterized by ease of entry; reliance on indigenous resources; family ownership; small scale operations; labour intensive and adoptive technology; skills acquired outside of the formal sector, and unregulated competitive markets\(^2\).

In Kenya, there is an ambiguity of operation associated with the informal sector as it has both formal and informal sector activities, that include the sale of food items, the sale of new and second hand clothes and shoes, small scale retailing, hawking, small scale manufacturing, production, construction and repairs.

While the terms “informal sector” and “Jua Kali” are often used interchangeably, the Jua Kali industry more specifically refers to small scale industry involved in manufacturing and repair. The Jua Kali industry is an economic phenomenon that may be unique to Kenya yet be comparable to other phenomena in other developing countries: it is characterised by a self-organizing community of largely informally trained mechanics, engineers and tradesmen\(^2\)\(^6\)\(^7\).

The term Jua Kali was coined by former president Daniel arap Moi in 1985 as he visited the earliest group of metal workers and tradesmen in Kamukunji. It is a term that literally translates to “fierce sun”, and refers to the harsh and outdoor working condition that the workers adopted for lack of premises. The workers often got together to share a small but prime plot that the owner may not have had the capital to develop, and to share their limited machinery, electricity and clientele\(^2\)\(^7\).
2.2 The origin of the Jua Kali industry.

The Jua Kali industry was introduced in 1960 by the government of Kenya under the advice of the International Labour Organization (ILO) as a low cost way of creating employment and increasing the country’s gross domestic product (GDP)\(^2\). The introduction of the 8-4-4 system of education saw to the rapid expansion of the sector as there were many school leavers without a commensurate increase in employment opportunities. Many of these school leavers opted to join the informal sector through this industry.

Previously, the Jua Kali industry was neglected by the government and denied rights to property, land, education and to credit facilities. Its economic contribution and organization into associations has facilitated its recognition and support by the government. The Jua Kali workers can now own land, access credit and are the major target of the recently launched Mbao pension plan, which is also known as the National Jua Kali Pension scheme. The scheme was developed by the National Federation of Kenya Jua Kali associations and the Retirement Benefits Authority, and its main aim is to encourage low-income workers to save at least Ksh 20 per day towards their retirement\(^28,29\).

2.3 Socioeconomic contribution of the Jua Kali industry.

The informal sector in Kenya has been recognized as the country’s greatest employer, employing 75% of Kenya’s workforce and contributing 51.6% of the GDP\(^27\). The Jua Kali industry, besides creating employment opportunities, especially for the youth who make up 70% of total unemployment in Kenya, is also involved in the production of simple and affordable goods for the local market, thus saving the country foreign exchange; in environmental conservation by the recycling of waste material, for example, scrap metal; in skills training; and in facilitating the decentralization of industries and hence discouraging rural to urban migration\(^27\).
2.4 **Jua Kali industry workers a high-risk group.**

As previously noted, work-related injuries occur most commonly and yet 90% of them are preventable. The KNH study\(^9\) done by Funjika, revealed that majority of the patients requiring hospitalization were injured by metallic objects from welding or grinding. Automotive industry workers are reported to have the highest incidence of open globe injuries, are the least likely to use PPE, and are more likely than the average worker to be injured or killed on the job\(^{15}\).

Jua Kali garage mechanics and metal workers form an important high risk group for several reasons.

- Majority of the workers in this industry are young, black, males, a group who have been shown not only to be at greatest risk of eye injury, but also with worse outcomes.
- Workers are often trained on the job and hence may not perceive threat of ocular injury, may delay to seek medical intervention in the event of injury, or may generally adopt the poor attitude and practices of their mentors or trainers.
- They may be of low socioeconomic status with probably low levels of education and literacy
- Are likely to suffer recurrent and severe injuries by multiple mechanisms that further predisposes them to even greater ocular and other injuries. They may suffer mechanical trauma from dusts and/or flying, sometimes hot particles, and this risk is aggravated by the increasing use of power tools; chemical trauma from battery acids and solvents; thermal trauma from sparks and spatter from arc welding and smelting; ultraviolet and infrared-induced damage which may be subtle but with profound effect, or a combination of all the above mechanisms.
- The working conditions further aggravate the situation. The Jua Kali workers often work in dusty, draughty conditions which may blow dust, molten metal and sparks into the eyes, and reflections from the sun may interfere with visibility. They lack proper work surfaces or designated areas for specific tasks, for example, for welding, grinding, smelting, forging or for overhead work. Tools are not properly fitted, may be poorly maintained or be inappropriate for the task. A reconnaissance visit to the study area revealed that workers also improvise systems to replace tools or work surfaces that they lack, for example by improvising fans over an open flame instead of using kilns, to facilitate forging and smelting processes, which in turn increase the number of flying, hot particles. The workers are often crowded in the small work areas, may have to work quickly to utilise the daylight hours, or if they have tasks that must be urgently completed, they may work under poor lighting conditions at night.
3. JUSTIFICATION OF THE STUDY.

More than 90% of the global burden of ocular trauma and morbidity is borne by developing countries such as Kenya.

The work environment is the commonest setting in which ocular injuries occur, and more than 90% of these injuries are preventable by the adoption of safety measures, and the appropriate and consistent use of personal protective equipment.

The toll of work-related ocular injuries in terms of cost to the patient, the visual limitation, treatment and productive hours is great; this cost is not only borne by the individual who suffers the injury but is shared by society.

Work-related injuries also occur among adult working populations and bears significant socioeconomic implications especially in developing countries such as Kenya which heavily relies on industries such as Jua Kali.

There are few studies on occupational eye safety done in Africa and in Kenya. This study will serve to identify gaps in the knowledge, behavioural patterns and beliefs that facilitate or hinder occupational eye safety, and will inform health and safety policy development and implementation in Kenya to reduce the incidence and socioeconomic costs of ocular trauma.
4. OBJECTIVES

4.1 Broad Objective.

To establish the knowledge, attitude and practice of occupational eye safety among Jua Kali industry workers.

4.2 Specific Objectives:

- To describe participants’ knowledge of the risks, mechanisms and prevention of occupational ocular injuries.
- To describe patterns of PPE use and health-seeking behavior in the event of eye injury.
- To describe participants’ attitude towards occupational eye safety.
5. **STUDY METHODOLOGY.**

5.1 **Study design and period.**

The study was a cross-sectional descriptive study carried out during the months of January to April 2013.

5.2 **Study population.**

All the Jua Kali industry workers in Nairobi who are involved in manufacturing and repair. The study done by Funjika\(^9\) at KNH in Kenya showed that majority of those who were admitted with severe injuries were Jua Kali workers whose work involved grinding and welding. Hence, two at-risk groups were selected for the study; Jua Kali metal workers and garage mechanics. The Jua Kali industry workers for this study were thus defined as Jua Kali garage mechanics and metal workers only.

5.3 **Study setting.**

The study was carried out in two areas of Nairobi which typify the harsh, outdoor working conditions of Jua Kali workers. The first was an area informally referred to as “Grogon”. It is an unmapped area along Kirinyaga road extending from the ring road to Globe flyover shown on the map (see appendix A). It is an area with a high number of Jua Kali mechanics. There are several shops selling auto spare parts but there are no physical garages, and no mechanics affiliated to any of these auto shops. Mechanics identify or are identified for particular work by would-be clients, and they proceed to work in whatever space is available, buying whatever spare parts may be needed from the auto shops or elsewhere. Some workers are apprentices under mentorship of older, more experienced mechanics but all categories of workers are paid for work done, viz, by piece rate.

The second area was the Gikomba Jua Kali in Kamukunji, an area with the largest number of Jua Kali metal workers (see appendix A). Workers are often organized in small groups making particular items, but similar to the garage mechanics, they are not specifically employed at or affiliated to any metal shed. Workers may have their own sheds, may co-own the shed with colleagues, or may be apprentices. Workers here are also paid for work done, viz, by piece rate.
5.4 Sampling

5.4.1 Sample size

The Hauser and Griffin empirical formula was used to calculate \( N \), the initial analysis sample, for qualitative research. According to this formula, \( N \) of 60 participants is the minimum sample required to assure that with a known prevalence of ocular trauma among black males of 22.5%, the probability of missing a perception is significantly reduced to less than 5% as to achieve data saturation.

\( N \) of at least 60 was used for the interviewer-administered interviews and nonparticipant observation.

5.4.2 Sampling technique

The initial sampling point was conveniently chosen (marked A and B on the map for “Grogon” and Gikomba, respectively), to start from one end of both study sites, such that subsequent sampling would continue from these points. Thereafter, purposive sampling was used to select participants until data saturation was achieved at 34 participants at the first study site, and thus an equal number of participants were selected from the second study site to give a total of 68 participants. The purposive sampling was to assure that a comparable number of workers performing various tasks were included in the study.

The names of the workers who gave written consent to be interviewed and observed were recorded in a register, but only their initials were recorded in their respective questionnaire. This was done because of the probability of interviewing and observing the same worker more than once as they do not have a fixed work space and may migrate in the general work space.

During the interviews and observations, a contact person was identified to facilitate sampling of participants for the focus group discussions (FGD). The FGDs were carried out in the late afternoon when most of the workers were available, with note taking and audio recording of the discussion, and in the presence of a moderator. The “Grogon” FGD was carried out at the work site while the Gikomba one was carried out in the Kamukunji Jua Kali association (KJKA) hall. Each FGD had twelve participants.

Participants for the key informant interviews were selected from the Kamukunji Jua Kali Association (KJKA) based on their position and availability. Three officials, the general secretary, organising secretary and treasurer were interviewed, in their capacity as officials as well as that of employer because all three were metal shed owners with employees and apprentices under them.
5.4.3 Selection criteria for participants.

Inclusion criteria.

All Jua Kali garage mechanics in “Grogon” area and metal workers in Gikomba Jua Kali, Kamukunji, who gave written consent to participate in the study were included.

Exclusion criterion.

Jua Kali industry workers who, after explanation of the purpose of the study and assurance that their participation would not harm them in any way and that all the information obtained from them would be held in strict confidence, declined to give consent to participate in the study were excluded.

5.5 Study procedure.

5.5.1 Introduction.

The principal investigator and research assistant liaised with the Kamukunji Jua Kali association for the Gikomba area to seek entry into the said study site after paying a fee to carry out the study at this site. The interviewers introduced themselves to the potential participants, individually and in some instances in small groups, stating the purpose of the visit.

5.5.2 Consent taking and data collection.

Details of the consent form included the following: the purpose of the research; what was expected of each participant including an estimate of the amount of time required for the interview; expected risks and benefits of participating; the participants’ freedom to participate or to withdraw from participating; protection of confidentiality, and the names and contacts of the investigators to be contacted for questions or concerns arising from the study.

Workers were then requested to participate in the interview and to be observed as they performed their regular work, and any one who agreed to participate was requested to sign the informed consent section of the questionnaire. The actual names of participants were recorded in a register together with the questionnaire number but only the initials were entered in the respective questionnaires to ensure confidentiality. The recording of three names in a register was a counter measure to ensure that no participant was sampled more than once. New recruits had their names checked against the register to ensure that they had not already participated in the interviews and observation.

Participants for the FGDs were identified by the respective contact persons in each of the sites, and a convenient time agreed upon by all would-be participants was set. At this time, the investigator and
moderator introduced themselves to the group, stating the reason for their visit, and sought the verbal consent of each of the participants. A maximum of twelve participants per FGD was selected. After introductions, the participants of the FGD were assigned numbers according to their seating arrangement from one to twelve, and all through the discussion, reference to participants was made using their assigned number and not their names. Note taking and audio recording of the discussions was done, in the presence of a moderator, using the FGD interview guide.

Three participants were selected for the KII as stated previously. The investigator and moderator introduced themselves to each of the participants, stating the reason for their visit, and sought verbal consent from each participant to be interviewed, and for the interview to be recorded. Each participant was interviewed separately, using the KII guide.

5.6 Data collection tools

Four tools were used for data collection; questionnaires and nonparticipant observation schedules for quantitative data, focus group discussions and key informant interviews for qualitative data (Appendix C)

5.6.1 Questionnaire.

The interviewer-administered, semi-structured questionnaire had five sections.

Part A gathered sociodemographic data.

Part B focused on the participants’ level of education, training for their current work, and their work experience in the Jua Kali industry.

Part C gathered information on history of work-related ocular injuries, and therefore, health-seeking behaviour in the event of work-related eye injury.

Part D sought to gather information concerning the participants’ knowledge of the risks of work-related ocular injuries, the prevention of these injuries, the use of personal protective equipment, and their sources of eye safety information.

Part E focused on the patterns of PPE use.
5.6.2 Observation schedule.

This was the second tool used to provide corroborative data specifically on PPE use. It was a nonparticipatory observation of workers as they performed their regular work tasks and consent for observation and recording of these observations was sought prior.

5.6.3 Focus group discussions.

Two focus group discussions, each with twelve participants and in the presence of a moderator, were conducted after the interviews were completed and mostly focused on workers’ attitudes towards eye safety, the injuries feared most among the workers, and reasons for delays in health seeking in the event of work-related eye injury.

5.6.4 Key informant interviews.

Three key informant interviews were held with Kamukunji Jua Kali association officials, who doubled up as employers since these officials were also shed owners. The interviews focused on the origin of the association, benefits of the association, eligibility of membership, employer-employee relationship, regulations of Jua Kali sector, safety concerns among association members, and the relationship between the association and the local government authority.

A pilot study was done at a Jua Kali garage in Kenyatta Market, and facilitated the validation of the data collection tools to assess the ease with which the questions were interpreted and understood, and the average duration taken to completely fill out a questionnaire. Relevant corrections and adjustments were made thereafter.

5.7 Data management and analysis.

Quantitative data were entered in Ms Excel and checked for consistency and completeness against the paper questionnaires and observation schedules. Quantitative analysis was done using Stata version 11.0 (Stata Corporation, College Station, TX, USA). The prevalence of eye injuries and proportions together with their corresponding 95% binomial confidence intervals were reported where appropriate. Chi-square tests were used to assess for differences in risk of eye injury and PPE use in the different levels of categorical variables including mode of training, duration of training, years of experience, and nature of work. A p-value of <0.05 was assumed to be statistically significant. Quantitative data was summarised using tables, bar graphs and pie charts.
Qualitative data was analysed using Nvivo QSR International, and summarised by summary codes. Qualitative data was summarised in textual themes with relevant quotes.

6. ETHICAL CONSIDERATIONS.

6.1 Confidentiality

Informed consent was obtained from all participants, with the reassurance that the study would not harm them in any way, would not directly benefit them, and that all the information obtained would be handled with strict confidentiality.

6.2 Ethical approval

Prior to the commencement of the study, ethical approval was sought from the University of Nairobi Ethics, Research and Standards Committee (Appendix A). Approval and liaison was also sought from the Kamukunji Jua Kali Association.
7. RESULTS.

Figure 1: Flow chart of data collection and analysis.

- Interviewer administered questionnaires/Interviews (N=68)
- Nonparticipant observation (N=68)
  
  Analysis Stata version 11.0 (N=68)

  Focus group discussions (N=2)

  Analysis Nvivo version 10 (N=2)

  Key informant interviews (N=3)

  Analysis Nvivo version 10 (N=3)
The participants’ ages ranged from 19 to 58 years, with an interquartile range of 23 to 32 years and a median age of 27 years. Majority were in the 21 to 30 year age group. All the participants were male.
Figure 3: Marital status (n=68).

Majority of the men were married (n=46, 68%).
Figure 4: Highest level of education completed (n=68).

All the participants had completed primary school. Majority 34 (50%) had completed primary school only, and 9 (13%) had received professional training at vocational or college level.
Majority (n=59, 87%) of the participants had been trained for their current work by apprenticeship, and 9 (13%) formally at vocational school or college level.
Most (n=32, 47%) of the participants were trained by apprenticeship for 12 to 24 months. 24 months was the average duration of training for those who were trained at tertiary levels of education.
Majority (n=22, 32.5%) had worked for 5 to 10 years, inclusive of the duration of apprenticeship. Only 4 (5%) had worked in the Jua Kali industry for over 20 years, and those who had worked for less than 1 year (8%) were currently under training by their respective mentors.
Figure 8: Daily activities performed.

Others in the key includes spray painting, panel beating, greasing, battery check and wiring.

The pie chart and key above show the variety of activities that the workers were involved in as well as the multiplicity and overlap of the activities an individual performed daily. Majority performed activities that involved hammering and welding.
Figure 9: Approximate monthly income.

Majority (n=32, 48%) earned between Ksh 10,000 and Ksh 20,000 per month.
The responses in the graph include more than one response per respondent. 59 participants, who were a significant majority of 86.8% (95% CI, 76.4 to 93.8%) of the workers were able to mention at least one activity that they or their colleagues perform that poses a risk of eye injury. Welding was identified by majority as the activity with greatest risk of causing eye injury.
Table 1: Knowledge of mechanisms of eye injury.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mechanism of injury</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding (N=37)</td>
<td>Penetrating injury/FB entry</td>
<td>83.8%</td>
</tr>
<tr>
<td></td>
<td>Thermal injury</td>
<td>40.5%</td>
</tr>
<tr>
<td></td>
<td>Radiation injury</td>
<td>78.4%</td>
</tr>
<tr>
<td>Hammering (N=27)</td>
<td>Penetrating injury/FB entry</td>
<td>96.3%</td>
</tr>
<tr>
<td></td>
<td>Blunt trauma</td>
<td>74.1%</td>
</tr>
<tr>
<td>Grinding (N=17)</td>
<td>Penetrating injury</td>
<td>100%</td>
</tr>
<tr>
<td>Wiring/battery check (N=3)</td>
<td>Chemical injury</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Thermal injury</td>
<td>66.7%</td>
</tr>
<tr>
<td>Overhead work (N=6)</td>
<td>Foreign body entry</td>
<td>66.7%</td>
</tr>
<tr>
<td></td>
<td>Chemical/thermal injury</td>
<td>83.3%</td>
</tr>
<tr>
<td></td>
<td>Blunt trauma</td>
<td>66.7%</td>
</tr>
<tr>
<td>Riveting (N=6)</td>
<td>Sharp trauma/penetrating injury</td>
<td>100%</td>
</tr>
<tr>
<td>Soldering (N=4)</td>
<td>Thermal injury</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Radiation injury</td>
<td>100%</td>
</tr>
<tr>
<td>Sanding (N=2)</td>
<td>Foreign body entry</td>
<td>100%</td>
</tr>
<tr>
<td>Pressure fitting bushes (N=3)</td>
<td>Mechanical injury</td>
<td>100%</td>
</tr>
<tr>
<td>Spray painting (N=5)</td>
<td>Chemical injury</td>
<td>20%</td>
</tr>
<tr>
<td>Scrubbing scrap metal (N=2)</td>
<td>Chemical injury</td>
<td>100%</td>
</tr>
<tr>
<td>Others (N=13)</td>
<td>Bystander effect/Assistant effect/transportation/storage</td>
<td>100%</td>
</tr>
</tbody>
</table>

Majority were able to correctly state mechanism(s) of injury associated with the activities.
Figure 11: Knowledge of eye injury prevention.

Most of the participants (n=50, 73%) mentioned personal protective equipment (PPE) as one of the ways by which eye injuries can be prevented. 76% (n=38) of those who mentioned PPE use were able to correctly match PPE to specific tasks in general but only 22% were able to state what PPE would be appropriate for the specific tasks that they were performing at the time of interview and observation.
Figure 12: How knowledge of PPE use was acquired.

1 More than one response per respondent

Majority (n=29, 58.8%) learnt about PPE from their colleagues, followed by mentors and trainers at 22%. Others learnt of PPE from their teachers/lecturers, from health workers’ advice following injury or by their own innovative improvisation/experience.
Figure 13: Best means of communicating eye safety information.

Other means of communication included barazas, informal visits, seminars and demonstrations of PPE use.

Radio and television were the most preferred means by which information on eye safety could be communicated. 70.6% (n=48) workers reported that they did not have adequate information and knowledge of how work-related eye injuries can be prevented, and 92.7% (n=63) wished to get more information about this.
Other activities include battery check, engine works, cutting metal strips, changing brake pads, pressing bushes, panel beating, riveting, spray painting, scrubbing scrap metal and sanding.

Majority (n=23, 34%) of the workers that were observed were performing tasks that involved hammering. Most were performing tasks with multiplicity of activities.
Table 2: Reported practice of PPE use (N=68).

<table>
<thead>
<tr>
<th>Reported practice.</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Owned PPE (n=68)</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>53 (77.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>15 (22.1)</td>
</tr>
<tr>
<td><strong>What PPE owned (N=15)</strong></td>
<td></td>
</tr>
<tr>
<td>Dark or clear goggles</td>
<td>13 (86.7)</td>
</tr>
<tr>
<td>Safety spectacles</td>
<td>2 (13.3)</td>
</tr>
<tr>
<td><strong>Reported PPE use (n=68)</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>49 (72.1)</td>
</tr>
<tr>
<td>Yes</td>
<td>19 (27.9)</td>
</tr>
<tr>
<td><strong>Frequency of PPE use (N=19)</strong></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>13 (68.4)</td>
</tr>
<tr>
<td>Always</td>
<td>6 (31.2)</td>
</tr>
</tbody>
</table>

Although 27.9% reported using PPE, only 22.1% reported owning PPE. Out of the 19 participants who reported using PPE, only 6 (31.2%) reported consistent use.
Table 3: Observed practice of PPE use (N=68).

<table>
<thead>
<tr>
<th>Observation.</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own PPE</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>55 (80.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>13 (19.1)</td>
</tr>
<tr>
<td>Observed using PPE</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>60 (88.2)</td>
</tr>
<tr>
<td>Yes</td>
<td>8 (11.8)</td>
</tr>
<tr>
<td>Appropriate PPE (N= 8)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1 (13.5)</td>
</tr>
<tr>
<td>Yes</td>
<td>7 (86.5)</td>
</tr>
<tr>
<td>Appropriate PPE handling (N=8)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1 (13.5)</td>
</tr>
<tr>
<td>Yes</td>
<td>7 (86.5)</td>
</tr>
<tr>
<td>PPE in good working condition(N=8)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2 (25)</td>
</tr>
<tr>
<td>Yes</td>
<td>6 (75)</td>
</tr>
</tbody>
</table>

Of the 19.1% (n=13) who actually had the PPE on site, only 11.8% (n=8) were observed using PPE. 86.5% (n=7) of those who were using PPE had the appropriate PPE and handled it appropriately.
Table 4: History of work-related ocular injury (N=21).

<table>
<thead>
<tr>
<th>Category</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevalence of ocular injury</strong></td>
<td>30.9% (95% CI, 20.3 – 43.3%)</td>
</tr>
<tr>
<td><strong>Injured eye(s)</strong></td>
<td></td>
</tr>
<tr>
<td>Right eye</td>
<td>4 (19.5)</td>
</tr>
<tr>
<td>Left eye</td>
<td>4 (19.5)</td>
</tr>
<tr>
<td>Both eyes</td>
<td>13 (61.9)</td>
</tr>
<tr>
<td><strong>Circumstance of injury</strong></td>
<td></td>
</tr>
<tr>
<td>Welding</td>
<td>7 (33.3)</td>
</tr>
<tr>
<td>Grinding</td>
<td>3 (14.3)</td>
</tr>
<tr>
<td>Hammering</td>
<td>5 (23.8)</td>
</tr>
<tr>
<td>Overhead work</td>
<td>1 (4.8)</td>
</tr>
<tr>
<td>Bystander</td>
<td>5 (23.8)</td>
</tr>
<tr>
<td><strong>PPE use at time of injury</strong></td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Most (n=11, 52.4%) reported eye injury within the last 1 year, and 38.1% reported injury within the last 2 years. 23.8% (n=5) suffered injury as bystanders. 100% (n=0) of those who reported work-related eye injury were not using PPE at the time of injury.
Majority (n=11, 54%) of the participants who reported eye injury had suffered mechanical injury from foreign body entry. 7 (33%), who represented the group with bilateral injuries, had suffered radiation injury from activities such as welding and soldering.
Most of those injured (n=7, 33.3%) did not take any action after eye injury, and only 5 (23.8%) sought medical attention at a health care facility.
Figure 17: Action taken after 24 hours of injury.

A vast majority (n=18, 85.7%) did nothing after 24 hours of eye injury, while 4.8% visited a health facility, self-medicated with eye drops or with oral analgesics and antibiotics, respectively.
Table 5: Multivariate analysis of factors affecting knowledge and practice.

<table>
<thead>
<tr>
<th>Categorical variable</th>
<th>Knowledge of eye injury risk (Chi square p value)</th>
<th>Observed PPE use (Chi square p value)</th>
<th>History of ocular injury (Chi square p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of training</td>
<td>0.062</td>
<td>&lt;0.001</td>
<td>0.085</td>
</tr>
<tr>
<td>Duration of training</td>
<td>0.673</td>
<td>0.123</td>
<td>0.749</td>
</tr>
<tr>
<td>Nature of activities involved in.</td>
<td>0.805</td>
<td>0.368</td>
<td>0.482</td>
</tr>
<tr>
<td>Duration of work experience.</td>
<td>0.399</td>
<td>0.260</td>
<td>0.904</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.152</td>
<td>&lt;0.001</td>
<td>0.133</td>
</tr>
<tr>
<td>Estimated monthly income.</td>
<td>0.460</td>
<td>0.390</td>
<td>0.425</td>
</tr>
</tbody>
</table>

Only level of education and mode of training, were found to have a statistically significant effect on PPE use.
Focus group discussions.

Figure 18: Ranking of bodily injuries according to perceived severity.

The first flow diagram (a) shows the ranking of injuries based on what bodily injuries were perceived to be most severe by the mechanics and the second by the metal workers (b).
Attitude towards work-related injuries.

“it is the Jua Kali way of life...here injuries are 90%”

The workers all agreed that they were at greater risk than the average person to suffer bodily injuries, and especially eye and hand injuries because of the nature of their work, and their working conditions. Many workers reported that bodily injuries are very common and rightly to be anticipated.

“because we work with eyes here, and if you lose them then that is it, you are out of the garage”.

“because the metal is very sharp, it can cut you so badly such that you miss work for three days or even a week!”

For both groups, the injuries that compromised their livelihood in any way were considered to be most significant and therefore most severe. Eye injuries were considered to be most severe among the mechanics, and injuries to the dominant hand among the metal workers,

“when dealing with the eye, all injuries are severe...once you injure your eye, that’s it...the eye cannot be repaired”

Most of the participants agreed that eye injuries are severe, and that they are also costly to treat.

“you don’t have to tell them...they will just see the sparks and move away”

The workers all agreed that even though a task they may be performing has a high risk of eye injury, to themselves and to colleagues, it was the responsibility of any bystander to move away from the hazardous activity or take any measure he sees fit to protect his eyes from injury. They agreed that they would most likely warn their clients to move or look away, but the rest would have to look out for themselves.
Change in attitude and practice following eye injury.

Many of the mechanics, and few of the metal workers reported having suffered injury or knowing a colleague who had suffered severe injury that resulted in hospitalization and/or blindness. The behavioural responses of the workers to these injuries were;

“apart from the fear...i started using goggles for a while...then I thought there is no need because the eyes feel strange and it is cumbersome, so I thought it better just to be careful”

Some attempted using PPE but this was only for a brief period before they reverted to not using it and only trying to be more careful.

“like when it gets to the part where I need to fix wires, I would rather pay someone to straighten the wires for me because I am scared”

Others resorted to totally avoiding or subletting the tasks that they consider risky to other people such that they reduce the likelihood of eye injury by not performing these tasks themselves.
Attitude towards PPE use.

During the interview and observations we found out that very few workers owned and even fewer used PPE, and we sought to find out why. The reasons why many do not use PPE was analysed and is reported under the following broad themes with relevant quotes;

“I don’t think I can get injured...”

Some workers were not ignorant of the threat of ocular injury.

“Only those doing activities like welding can get eye injury”

Some participants thought that eye injury was likely when one did “high-risk” activities such as welding, but not low risk activities such as sanding. Others further conceded that it is only those doing arc welding and not other types of welding such as gas welding who get injured.

“I cannot get injured when soldering or welding for just a few minutes”

Others felt that the likelihood of injury is reduced when the task is brief, hence there is no need to use PPE for brief tasks.

“I cannot afford to buy it...it is very expensive”

Workers reported that most PPE was not affordable to them. Others felt that continually replacing welding goggles which would darken over time and use, or on getting many scratches, which significantly reduced visibility, was too costly to maintain. Further probing revealed that many did not actually know the cost of the various PPE but assumed it was costly.

“I don’t know where to buy it...I don’t know which one will be good for me”

Some workers were ignorant of what PPE was available, what would be suitable for their specific tasks, and even where they can purchase it. Others felt that it was better not to have any PPE than to “spoil the eyes using the street goggles”.

“time is money!...people here are more concerned about getting the job done so it’s not about ignorance, it’s about going for the money...it really slows you down and you want to increase your pace because you are paid for the work that you do”

Majority agreed that it was inconvenient and time consuming to keep wearing and removing PPE when doing multiple short tasks, or when re-assessing the task, when this time could be spent doing more work to get more money. Hand-held devices such as welding shields that limited their manual dexterity
also slowed down their work and were considered impractical when a worker desired to have both hands free.

“I don’t see very well when am using these things.”

Poor visibility of the work, especially for those doing overhead work without a suitable work surface, or due to fogging hindered others from using PPE.

“I have never seen anyone using them...never been taught about them.”

Lack of mentor or supervisor influence left some workers ignorant of the risk of eye injury or of PPE use, and made others feel that PPE may not be necessary especially if their trainers did not, according to the workers’ knowledge, suffer any eye injury.

“accidents cannot be prevented...the ill-fated will suffer.....if it is your day, it is your day”

Many workers were in agreement that eye injuries, like all other bodily injuries, occur by accident, and just like all other accidents, they cannot be prevented. Others had resigned themselves to fate, stating that it may not really matter whether or not one wears PPE, and that if one is destined to suffer injury, one will no matter.

“you see here if you get 500 shillings you cannot start thinking of buying goggles and yet your family depends on that money”

Some workers felt that buying PPE was extravagant in the face of other competing priorities. Many agreed that they cannot “sacrifice” their money to buy PPE, in the face of other pressing family needs such as food, shelter, and school fees, even if it meant that this sacrifice would mean a greater likelihood of more productive years unhindered by eye injury compared to the daily risk of eye injury.

“you cannot teach an old dog new tricks...I have been doing it this was for so long now and I have not had an eye injury”

Workers with many years experience, particularly those without a history of work-related eye injury, felt that they were too old and/or too experienced to be taught about PPE. They expressed an inertia to embrace new ideas or technology, including the use of PPE.
“I don’t know what type of goggles will be good for this kind of work...I think if I wear the goggles and this cuff breaks, then I can suffer more injury than if I was not.”

Workers whose work involved pressure fitting car bushes using an improvised hydraulic system expressed that they did not know what PPE would be suitable for this particular task. They felt that the likelihood and severity of injury would be greater if one was wearing PPE when one or more of the metal cuffs containing ball bearings broke, dispersing these bearings under high velocity. The ball bearings would not only shatter the PPE but also compound the magnitude of any injury sustained.

“The employer should provide the goggles...am not willing to buy goggles to do someone else’s work”

Few of the workers who were employed felt that it is the responsibility of the employer to provide safety wear, and also to meet the costs of injury should any occur. Even though most of them agreed that they are the ones who would suffer most, regardless of who bought the PPE, themselves or their employer, many were still reluctant to buy their own PPE.

“why should I buy the goggles when nobody here has been injured... some of them have worked for me for over five years?”

Conversely, some of the employers were reluctant to provide PPE, citing the zero rate of work-related eye injury among their workers. Some were also not convinced of the efficacy of PPE or whether the workers genuinely feared for their eye safety when they had previously not raised any concerns for the several months or years that they had worked. They simply urged their workers to “be more careful...as I have been all these years”.

“you see I may bring you some work and then you go off looking for the goggles, but you see here the work is fast paced so they may think that you are not interested and give the job to someone else”

Few of the workers thought that those who wear goggles may be doing so out of pride, and others felt that these workers may not be ready to work as they “waste time” looking for and wearing the PPE.

“you know there are people who don’t care, even if you brought something that will help them, they are not bothered”

Few reported that some workers were simply apathetic and could not be helped.
Attitude towards health-seeking behaviour.

During the interviews and observation, we also found out that majority of participants who had suffered work-related eye injury did not visit a health facility, immediately or later, and the following are the reasons for delays in seeking or not seeking medical attention, presented in broad themes with relevant quotes:

"the injury was minor...the eyes will get used to it"

Workers felt that their injuries were not of sufficient gravity to warrant a hospital visit, particularly if they judged that their vision was largely unchanged. Others thought that it is just the nature of the work and that with time, the eyes will adapt to the pain and discomfort such as that associated with welder’s photokeratitis.

“now the metal was removed by my colleague...am still seeing very well”

Those who had superficial foreign bodies from activities such as grinding or welding that had been “successfully” removed by their colleague did not feel the need to visit a hospital as the cause of the problem had already been dealt with. A blade of grass was the most common foreign body removal tool, but few mechanics had reported using a magnetic vehicle part such as from an audio speaker to attract the metallic foreign body. Thus, only those whose vision had worsened or who had persistent foreign bodies visited a health facility.

“time is money!..maybe because you are rushing to finish the work so that at the end of the day you are paid”

Many workers agreed that they preferred to strive to complete the task they were performing at the time of injury so that they could be paid, and thereafter go to hospital, probably using the money they had just received. Others, particularly those who perceived their injuries to be minor to moderate, felt that they would rather self-medicate than “waste time” seeking medical attention when they could continue working to get more money.

“mainly it is because you don’t have that money and so you tell yourself that you will try and raise funds so that you can go to the hospital”

Majority of the workers reported that many do not seek medical attention at health facilities because of their prohibitive costs. They also mentioned their lack of preparedness for any such emergencies and may delay seeking medical attention as they try to get some money for the same.
“these city council clinics give us false hopes”

Many agreed that though the consultation charge of Ksh 20 was affordable to most of them, the city council clinics were often not able to treat eye injuries and also did not have enough medicine, eventually referring them to larger health facilities where the eye injuries may be attended to, or writing them prescriptions to buy medicine elsewhere that would end up being very costly. The end result is that the workers would have lost several valuable man hours, together with not being able to afford the consultation costs at the referral unit, or to buy the prescribed medicine.

“so you’d rather do first aid on yourself then go to the hospital the next day... you apply brake fluid and you relax”

Many delayed seeking medical attention after getting relief from first aid measures such as washing their face and eyes, and in some instances, applying brake fluid!.

“I felt better after buying some medicine from the chemist”

Temporary relief after self-medication with over-the-counter topical eye drops, oral analgesics and antibiotics provided comfort enough for the worker to continue with work and to postpone seeking medical attention. Others eventually sought medical attention after several days of self-treatment without significant improvement or with worsening symptoms.

“I am not sure where to go...I don’t think just any hospital can deal with eye injuries”

Some were not sure which facility would be able to handle eye injuries without referring them, as many preferred to save time by going to the most appropriate facility rather than visit any facility only to be referred to another.
Key informant interviews.

“the formation of the Jua Kali cannot be said to have started at a particular time”

The officials interviewed explained that the commencement of what is now known as the Jua Kali sector is difficult to establish but largely grew out of individual or family groups that were mostly involved in repairing household items such as metal basins “karaais” and cooking pots “sufurias”. Later, those who had worked in Indian households were involved in teaching their family members certain trades that involved manufacturing household items, that they had learnt from these households. Eventually, it was adopted by the government as a low cost way of creating employment for the youth.

“the government required us to have a voice...a body that they can address”

The Kamukunji National Jua Kali association was formed in an effort to have a body that the government could recognise and specifically dialogue with rather than individuals, and this prompted its formation and registration as a government-recognised body, and subsequently, other Jua Kali associations.

The association has more than five thousand registered members. All workers in the sector, including apprentices are eligible and are encouraged to join, at a nominal fee of Ksh 100 to join, and an annual retention fee of Ksh 30. The association benefits the members by providing some work space, ensuring that they are not illegally charged taxes by the local authority as long as they are working within their designated Kamukunji Jua Kali zone, lobbying for minimal taxation for the importation and transportation of raw material such as scrap metal, collaborating with the government through the ministry of labour to have regional exhibitions of their goods at minimal cost, preference of registered members to sell their wares to agreed upon local supermarkets, work-related safety trainings organised by the ministry of labour, and the provision of health insurance schemes at a lower rate to members.
“we do not know of any regulating body...no activity is considered illegal here”

The officials were not aware of any body or government arm that regulates the activities within the sector. Even though they agreed that some of the activities the workers may perform, especially those done using improvised systems, have a high risk of injury, to the workers performing these tasks and to their colleagues and bystanders/passersby, no activity was banned or considered illegal. Further, no health hazard survey had ever been conducted in the area, according to their best knowledge.

“no they haven’t complained but they are suffering, ...that is just the way life is here”

The officials were not aware of any specific work-related health and safety concerns that had been raised by the members but agreed that they did not have to be told that they were working in less than ideal conditions with a significant likelihood and prevalence of eye and other bodily injury. Because no specific complaints have been raised, the association had also not dealt with health and safety issues but had resigned its members to continue working under these very unfavourable conditions.

“ I am aware that there are some laws but I cannot tell you what these laws say or how they can be implemented”

The officials were not specifically aware of the Occupational Health and Safety Act, its details or its implementation. They agreed that if any such laws governing occupational safety exist, then they should be strictly implemented to assure the safety of workers and were willing to co-operate with the concerned bodies, even if it meant paying more taxes to assure that they have a safer work environment.

“we do not provide any safety wear but we expect the workers to be careful...what happens when a worker suffers eye injury depends on the employer”

It was not agreed that the employers should provide PPE even though they felt that these may be useful. In the event of work-related injury, most employers would provide funds, not deductable from the worker’s pay, for the worker to seek medical attention. However, many of the workers would not go
immediately, preferring to finish a particular task or the day’s work because of the opportunity costs of being away seeking medical attention.

“That one is difficult to say...they have helped us but sometimes they harass us”

Although the officials had difficulty describing the relationship between the association and the local government authority, specifically the city council, they felt that the government has been instrumental in developing the sector, and would be even more influential as it hopes to expand the sector in line with the micro and small enterprise bill (MSE) 2011.

“The government can assist us by building more sheds for us, giving us more land...including us in the Industrial Act and looking into what we do...”

The officials expressed a desire for the government to really investigate and find out the activities the Jua Kali workers are involved in, and to understand the conditions under which they work. They also desired to have the government set up a legal framework under which the Jua Kali operate because so far, they felt that they were a neglected group, left to their own devices. The officials reiterated the enormous contribution of the Jua Kali industry to the socioeconomic growth of the country and desired that much more consideration by the government to facilitate the growth and safety of the industry be given.
8. DISCUSSION.

Demographic characteristics.

Majority of the participants interviewed were aged between 21 and 30 years, with an interquartile range of 23 to 32 and a median age of 27 years. All participants, for the interviews, observations, focus group discussions and key informant interviews were male, majority (68%) of whom were married. Funjika\(^9\) found that majority of those who were admitted with severe eye injuries were in this age group. This has a significant bearing as it implies that majority of the workers are young with a long span of work years that may be abruptly and severely affected by work-related eye injury. The fact that majority are also married further aggravates the socioeconomic burden of ocular trauma because it means the loss of household incomes, or the diversion of family income to meet the huge costs of medical treatment in the event of injury.

All the participants had completed primary school, 50% had completed primary school only, 38.1% had completed secondary school and only 11.9% had completed tertiary level training at vocational or technical colleges. That majority had completed only primary school implies that they probably joined the industry from a young age, and that they may have limited choices of earning a living such that they may be forced to work in this industry for most of their productive years.

Majority were trained by apprenticeship with majority having undergone training for between 12 to 24 months. However, the duration of apprenticeship given may not be very accurate because the transition between apprenticeship and mastery is ill-defined as there is rarely an actual point where the mentor or trainer acknowledges that his apprentice is now “qualified”. Further, apprenticeship remains an ongoing process as one continues to learn new skills or new ways of performing their various tasks. Mentors and trainers are thus an important group to target for inclusion in the dissemination of eye safety information because most of the workers are trained by apprenticeship. Apprentices get recruited often by their relatives who are already in the trade, and these relatives would host their apprentices for some duration of their training until the apprentices are self-reliant. “Soft agreements” of training and pay of the apprentices are generally agreed upon by the parties involved. More than 60% had worked in the industry for between 1 and 10 years, inclusive of the period of apprenticeship. Majority of the workers reported working seven days a week, including public holidays, several hours a day to utilise the daylight hours.
The participants were involved in a variety of activities and majority of these activities are associated with high risk of eye injury. Further, the multiplicity of the activities involved in each task was attended with multiplicity of exposure risk. For example, a mechanic whose main activity is panel beating performed activities that involved sanding, hammering, welding, soldering and spray painting, such that he is exposed to high risk of eye injury by various mechanisms from the different activities. This is consistent with findings from other studies \(^9\) that have identified workers in automotive or metal work industries to be at high risk of eye injuries, and this may be one of the important reasons why.

Majority (48\%) of the participants earned an approximate monthly income of between Ksh 10,000 and Ksh 20,000, working seven days a week, and which translates to USD 3.9 to 7.8 per day. Those who earned more than Ksh 30,000 were owners of metal sheds. The money earned per month varies with the amount of work done as majority are paid by piece rate, hence the rush to do as much as one can since it directly translates to more money. Doing work in a hurry was significantly associated with a high risk of work-related eye injury\(^{33}\).

Though there were some employers, the employer-employee relationship is not fixed. Workers may be affiliated to a shed owner or mechanic for a specific time period or for the duration of a specific task. Workers also do not also have a fixed work space but rather, they work in the space available. Whatever the work arrangement, all workers were paid for work done often upon completion of the work, viz, by piece rate.

Several of the sociodemographic characteristics of the workers identify them as a high-risk group: male gender, youth in the high risk age group of 21 to 30 years, low levels of education, and probably low socioeconomic status\(^8\). Further, the nature of their work, the unsuitable outdoor working conditions, the lack of appropriate work surfaces and designated areas, overcrowding as shown in photographs 1 to 8 (Appendix E), working long hours, and working in a hurry all increase the likelihood of work-related eye injury\(^8,31\).

**Knowledge.**

A vast majority (86.8\%) demonstrated knowledge of activities that were associated with high risk of work-related eye injury (95\% CI, 76.4 to 93.8\%). Majority were able to accurately state the various mechanisms associated with the different activities(Table 1). This was consistent with other findings of studies done by Ajayi et al, and Frebai in Nigeria among Industrial welders where there was more than 90\% awareness of the risk and of the mechanisms of eye injury\(^{32,34}\). Knowledge of the threat
of injury was independent of whether one received formal training or informal training by apprenticeship.

Many of the participants (73%) had knowledge of how work-related eye injuries may be prevented, and were able to accurately name several PPE that could be used to prevent injury. Of these, 76% were able to match PPE with various tasks in general, but only 22% were able to match PPE with their own specific tasks that they were performing at the time of the interview and observation. Welding was identified by many as a high risk activity, and majority knew how injuries due to welding could be prevented.

Only a few (6%) had misperceptions of how eye injury could be prevented: some thought that eye injuries could be prevented by using a cap when doing overhead work, wiping spills off one’s face, drinking milk when doing a dust-generating activity such as sanding, or looking away when from the work when welding or soldering.

Majority (92.7%) reported that they wished to get more information about work-related eye safety, and radio was the single most preferred means by which eye safety information could be communicated to them, mostly because they could carry on with their work while they listened to this information, which they could also get through their mobile phones. Television was the next preferred means, because of the reinforcing visual input. Printed, textual media such as newspapers, pamphlets and magazines were least preferred since the workers felt that they often do not have time at work or energy to read later in the evening when they got home. Informal barazas and physical demonstrations at the work site were means preferred by others, but this may be difficult to implement because it may be a challenge to get a group of these workers together at the same time for them to participate in these activities.

**Practice of work-related eye safety.**

Although 73% of the participants were aware that PPE use was one of the ways by which work-related eye injury may be prevented, only 22.1% of the participants reported owning PPE, which was slightly less than those who reported using it (27.9%), probably because the workers may have borrowed PPE from their colleagues for short periods (Table 2). Only a minority (31.6%) of those who reported using PPE reported consistent use. Further, compared to the 27.9% who reported using PPE, only 11.8% were actually observed using PPE. Ajayi found that though 45.9% of the welders had PPE, only 9.6% reported regular PPE use. This is consistent with what several studies have shown, that even when the benefits of PPE use are known and PPE is provided, compliance of PPE use remains
A locally relevant case in point is the Eardrop Operation Kenya, a yearly activity organised by the Retired Benefits Authority (RBA), in conjunction with the ministry of labour and several Ear-Nose and Throat (ENT) specialists. Eardrop Operation Kenya was set up with two main aims: to hold yearly free ENT clinics in a major Jua Kali zone, and to conduct a noise survey of this zones, so that they can educate Jua Kali workers on work-related ear safety and to provide ear PPE to reduce work-related ear injury. Kamukunji Jua Kali in Gikomba was the initial project, carried out in May 2010, and subsequent projects have been held at Kibuye Jua Kali in Kisumu, Mombasa Jua Kali and the last was in Kakamega Jua Kali in 2012. During the free clinics, more than 1000 workers per zone were registered, had a hearing assessment, and were given free ear plugs. Of significance to this study were findings that in all the four zones, more than 75%, and in some zones, more than 95% of the workers were exposed to hazardous occupational noise levels according to the noise surveys. However, during our reconnaissance visits, and also during the entire period of the data collection, the investigators did not see even one worker wearing his ear PPE. On probing, we found that some of the workers reported that their hearing seemed to be worsened by the ear PPE, even though the same metal workers ranked noise-induced hearing loss as severe. This suggests that to enhance PPE compliance, a multifactoral, behavioural approach is to be adopted.

Of the 11.8% who were observed using PPE, 87.5% had completed tertiary level education and had received formal training for their current work. This was statistically significant with p value <0.001 on Chi square testing. This may imply that those who had tertiary level of training better understood the inherent risks of eye injury, and could, by foresight prioritise their eye safety by investing in and consistently use PPE. 87.5% of those observed using PPE had PPE appropriate for the tasks they were performing at observation, and the PPE was handled appropriately covering the relevant area to be protected. 75% had the PPE in good working condition, without scratches, multiple repair marks, broken or improvised parts, or cracks. Only 1 participant had inappropriate PPE, an improvised face shield made out of carton box, which he wore over his welding goggles. He explained that he devised this as a way of reducing smoke entering his eye when welding, and that it had been “effective”.

There is no clear definition of what constitutes appropriate PPE in our setting. The Occupational Health and Safety Act last revised in 2010, gives a general outline of high risk activities and the PPE that should be worn or held when performing these activities. In developed countries such as Canada, Australia and the USA, PPE description details include PPE suitability for the task at hand, the material
the PPE should be made from, the distance from the work at which the PPE is to be used that factors in the amount of exposure, for example, amount of radiation generated per surface of work or the amount of particles/dusts generated from an activity, appropriate tint factor for activities with radiation exposure, and most importantly, a safety standardization mark that is clearly labelled on the frame and/or side shields for the respective country\textsuperscript{12,25}.

The safety standardization mark is a quality assurance mark that indicates that the PPE has been tested for strength, durability, safety and significant risk exposure reduction in a variety of settings where the PPE is to be used. It also facilitates the identity of the manufacturer such that any complaints arising from the use of a particular PPE can be directly addressed to the manufacturer. Locally, however, most of the PPE available lack the manufacturer’s identification label, safety standardization mark, and instruction manual indicating what the specific PPE is used for, how it is used, how it is maintained or how often it should be replaced. This raises the question as to the benefit of using such PPE as they may be inadequate and unsafe, and may also falsely reassure the user(s). This is a matter of great concern as it shows that the government has neglected to ensure that locally available PPE is standardized for safe use locally, also taking into the consideration the work environment where these PPE are used.

Another important observation noted about locally available PPE is that they are available in one size. And this is true in other parts of the world, including developed countries. This is one of the factors that has been identified as a cause of poor PPE compliance, because of the discomfort of wearing an ill-fitting device\textsuperscript{24,25}. Ajayi et al found that the discomfort of wearing PPE was the commonest reason why majority of the welders in their study were not using PPE despite a 90.6\% awareness of the risk of eye injury\textsuperscript{34}. Ideally, all PPE should be custom-made to properly fit the individual, and to include his or her vision needs. For example, those who wear refractive correction should have PPE that can adequately be used over their regular correction or have PPE with the relevant refractive correction factored in\textsuperscript{24}.

**Attitude towards eye safety.**

A number of workers, 30.9\% (95\% CI, 20.3 -43.3\%) of the participants reported a history of work-related eye injury, majority (54\%) of which occurred within the last one year and 38.1\% within the last two years. This shows that more than 90\% of the participants reported eye injuries in the last 2 years, and this can be extrapolated to mean that eye injuries occur at a high rate among these groups.

 Majority (62\%) had suffered bilateral injuries while 19\% had suffered right or left eye injuries respectively(Table 4). All those who suffered eye injury were not wearing PPE at the time of injury. Studies have shown that even when workers are educated on the benefits of PPE use, are provided with
PPE, and are continually reminded to use PPE, compliance has remained very poor. Further, a history of work-related eye injury does not deter PPE noncompliance. Mansouri found that despite a 44.3% prevalence of work-related eye injury, only 2.2% were using PPE at the time of subsequent injury. Activities that were mostly commonly associated with injuries were welding, hammering and grinding, and the predominant mechanism of injury was mechanical injury by a metallic projectile generated during these activities. Dannenberg found that more than 72% of injuries in the workplace were caused by projectiles. This is consistent with what other studies found as the predominant mechanism of injury among these high risk groups and upon review of patients admitted at KNH with severe work-related eye injuries. Welding has been identified as one of the most high risk activities, not only because of the multiple mechanisms by which it can cause severe injury, but also because some of the injuries, such as welder’s photokeratitis may be subtle, and only be discovered when they have already caused profound visual impairment.

Of note, is the high incidence of trauma to innocent bystanders, the “bystander effect”. Workers sustaining injury by an activity being performed by a colleague or nonworkers getting injured by activity being performed by workers at the work site when they visit to purchase products, or even as they pass through the Jua Kali area. This may be due largely to the overcrowding at the work site and the lack of adequate and suitably designated areas for the mechanics or metal workers. For example, since the construction of the Kamukunji Jua Kali sheds in Gikomba in 1984, the number of workers has significantly increased, without a commensurate increase in the number of sheds or expansion of the work space. Further, there may be less migration of workers out of Nairobi back to the rural areas upon completion of their apprenticeship, which was one of the principles upon which the concept of Jua Kali was established. Workers also reported that they or their colleagues may be injured by scrap metal due to inadequate storage space in the already overcrowded sheds, and some workers were observed having to balance precariously over scrap metal to get to their work space among heaps of jagged metal.

We found that only 23.6% of those who reported a history of work-related eye injury visited a health facility immediately compared with the 33.3% who did not take any measures, and after 24 hours, only 4.8% visited a health facility compared with 85.7% who did nothing. Funjika found that only 32.5% visited hospital immediately, while majority (46.4%) visited a health facility after 24 hours. However, the proportion of those who did not visit a health facility, whether immediately or later, was still greater than those who did. Ilsar et al, found that the average duration between injury and first presentation to a health facility was ten days. Funjika also found that of those who presented to a
health facility and were admitted for surgery, only 47.9% presented for the first post-operative review, and by the third review, only 22.3% presented to the hospital.

On exploring why workers presented late or not at all to a health facility, we found that the predominant reasons were that the injuries may have been perceived as minor and therefore not of sufficient gravity to warrant medical attention. Others felt that the cost implications of visiting a health facility and foregoing money that would have been earned in that time hindered them. The lack of money to go immediately, relief from temporizing measures, and competing priorities were the other major reasons. These all show that despite a high level of awareness, there was a lack of preparedness to promptly deal with eye injuries. Ilsar found that use of traditional medicine was responsible for some of the delays, with the injured eventually presenting to hospital when these treatments had failed or when symptoms worsened.

Though many of the participants agreed that PPE use is beneficial, we found that the main reasons why many workers did not use PPE were that they were ignorant about necessity of PPE, about where and what PPE to buy, the cost implications of buying PPE, competing priorities, poor visibility on using PPE, reduced manual dexterity, the lack of supervisor influence, inertia to change and apathy. Discomfort from ill-fitting PPE and fogging were found to be the commonest reasons why workers do not use PPE, which was different from what we found and this difference can be explained by the very low rate of PPE use. In the developed countries, other factors such as PPE not being attractive-looking, PPE not being accessible from work site, or the lack of reminders to use PPE were more commonly cited. The reasons for poor PPE compliance and for delayed health-seeking in the event of injury suggest a very poor attitude towards eye safety, and profit or income taking priority over this.

From the factors described above and the scenario described about the Eardrop operation, it may not be enough to educate people on the risks of work-related injury, to provide PPE, and to remind workers to use PPE. A multicomponent behavioural process that takes into account: factors attributable to the user such as knowledge, attitude, skills, tolerance, sensitivity and risk perceptions; factors attributable to the device such as comfort, complexity of use and protective efficacy; factors related to the task such as complexity, variability, interpersonal dynamics, hazard frequency and psychophysical demands, and most importantly, factors attributable to the context of PPE use such as the work environment and the social organization must all be taken into account to facilitate the adoption of work-related eye safety and the use of PPE.

The micro-and small enterprise (MSE/SME) bill was passed by the Kenya parliament in December 2011, sponsored by the Kenya Private Sector Alliance (KEPSA), to facilitate Vision 2030,
whose main aim is to industrialise Kenya to a middle income country providing a high quality of life to all its citizens by 2030, in line with the eight millennium development goals. The MSE bill in turn has two main aims: to provide a legal framework for activities in the Jua Kali sector, and to provide loans to workers at a very competitive rate of 8% from the Ksh 3.8B MSE fund.

Vision 2030 currently has more than one hundred and twenty flagship projects planned and these are to be implemented in successive 5 year medium-term plans from 2008, in four major development areas. These areas are research and development under the Kenya industrial and research development institute(KIRDI), Intellectual property under Kenya industrial property institute (KIPI), quality assurance under Kenya expanded programme of immunization (KEPI), and SME manufacturing under the Kenya Federation of Jua Kali associations(KFJKA), in conjunction with the Kenya national chamber of commerce and industries.

Under the SME manufacturing, the government plans to establish 5 pilot SME parks, and eventually expand to establish at least one SME park per county. The government thus has a very good opportunity to plan for the SME parks to ensure that they are well-located, away from where people live or pass, built to optimise work-related safety, and that activities carried out in these zones are well regulated. The government should specifically design areas where finished products can be exhibited or sold without risk of injury to those coming to see or buy these products. It is also an opportunity to revise the already established Jua Kali zones to make them safe, and to facilitate the migration of workers out of the cities and into the rural areas to continue with their trade, thereby reducing congestion in these work areas.

The government can further utilise the already established apprenticeship arrangements by which most of the workers in this industry are trained to influence the adoption of work safety practices to minimise the burden of work-related eye trauma.

The high levels of awareness of the risk of work-related eye injuries, and the high rates of injury found in this study and several others, do not seem to influence workers to consistently use PPE. A multifactorial approach is the most effective way to counter negative attitudes and apathy towards eye safety. Further, prevention of eye injuries, is by far better than treating them because this study has also shown, consistent with other studies, that many workers do not promptly seek medical attention in the event of injury, and the few who do, delay to do so. Funjika found that because of these delays, many patients with severe injuries presented to hospital blind and were discharged blind in the injured eye(s)\textsuperscript{9}. Jua Kali workers, and all other workers at high risk of work-related injuries, should prioritise their eye safety, and place it well above any amount of money they can make, and should take personal
responsibility for this because as we have seen, the burden of ocular injury will be greatest to the worker and his family. The government needs to facilitate the safety of the workers and of the public by ensuring a safe work environment, and the availability and affordability of appropriate PPE.
LIMITATIONS OF THE STUDY.

1. The interviews and observations were conducted under the pressure of time as many of the workers were willing to participate in the study on the condition that they did not have to stop what they were doing. The quality of the responses may have been reduced as the interviewers quickly asked questions and the participants gave brief responses/explanations to save time.

2. It was difficult to control the crowd when conducting the FGD at “Grogon” because it was done at the site. Though we had identified a group with a maximum of twelve participants, it was impossible to prevent others from crowding to see or hear what was being done, and as the interview progressed, we had nonparticipants responding to some of the questions.

3. For both the FGDs and the KIIs, the quality of the discussions and the audio recording of these was interfered with by the fairly loud background noise of hammering, hooting, or people talking.

4. The interviewers also feared for their own work-related eye safety during the period of the data collection. They felt that if they carried out the data collection wearing some kind of PPE then this would somehow bias the responses of the participants and hence decided not to wear any device. This meant that the interviewers were not relaxed during the data collection, and just like the workers, were in a hurry to complete the interviews and observations.
CONCLUSIONS.

1. There is a high level of awareness of the risk of eye injury (86.8%) and of the mechanisms by which work-related eye injuries occur.

2. There is a relatively high level of knowledge of the use of PPE (73%) to prevent eye injury.

3. There is a very low rate of PPE use among Jua Kali workers (11.8%), and PPE use was significantly correlated with level of education and mode of training for current work (p value <0.001). The main reasons for poor PPE compliance were ignorance and cost implications of buying PPE.

4. There is poor health seeking behaviour in the event of work-related eye injury with majority not presenting at all to a health facility. The main reason for this was the cost implication in terms of consultation or admission fees, and in terms of lost work opportunities while seeking medical attention.

5. There is a poor attitude towards work-related eye safety, and this may explain the gap between the high levels of knowledge and the low levels of practice. The provision of PPE does not necessarily enhance PPE compliance, a multicomponent behavioural approach must be adopted to enhance PPE compliance.
RECOMMENDATIONS.

Recommendations to the Jua Kali workers.

1. There is need for the Jua Kali associations and workers to organise for work-related safety training in a manner that will be of most benefit to them, for example, by having safety trainings at the work site where workers are not required to be away from their work for several hours.
2. The workers are to be encouraged to use PPE because PPE use has been shown to be efficacious, and the impact of work-related eye injury will be greatest to the worker and his family.
3. Workers are to be encouraged to take up NHIF enrollment or other health insurance schemes, or set up an emergency medical fund that will facilitate more prompt health seeking in the event of a work-related eye injury.
4. Workers, in conjunction with their respective association, should consider segregating specific tasks to designated work areas where uniform PPE may be adopted by all workers in this area. For example, they can specifically designate a welding zone so that all workers entering this zone must have their welding goggles.
5. The workers could also consider “subspecialising” so that instead of doing different tasks involving different activities, they could just do one activity and so reduce the multiple exposure risk.
6. The workers should be discouraged from having minors and other non-Jua Kali persons in the area to reduce the likelihood of injury to these innocent bystanders and passersby.
Recommendations to the government.

1. The government should provide eye safety information to specifically target the poor attitudes towards occupational eye safety, and would most effectively do this using radio, television, informal barazas and on-site safety trainings.
2. There is need for the government to promote the availability of quality and affordable PPE, and ensure that these have been relevantly tested and standardized for safe use locally.
3. The government is instrumental in facilitating the creation of safer work environment for the workers, with more spacious work areas to minimize overcrowding, with well-designed storage and dumping sites, eye and face wash stations, and water closets.
4. It should provide sheds or sites, away from the manufacture or repair sites, where workers can exhibit or sell their wares with minimal risk of injury to the public.
5. The government needs to revise the existing Occupational Health and safety act, and make it comprehensive as to include the Jua Kali workers.
6. The government needs to take a very active role in the development and implementation of a legal framework under which the activities in the Jua Kali sector are to be regulated, to assure eye safety for workers and the public in accordance with the MSE bill 2011.
7. The provision of incentives to those who consistently use PPE and for employers who provide and encourage consistent PPE use.
8. The provision of incentives to encourage urban to rural migration, and hence minimize overcrowding and the inherent risks of eye injury.
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APPENDIX A: ETHICAL APPROVAL.

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19767 Code 0202
Telegrams: varsity
(254-020) 276300 Ext 4355
Ref: KNH-ERC/A/61

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke

Dr. Alexandria C. Mashep
Dept. of Ophthalmology
School of Medicine
University of Nairobi

Dear Dr. Mashep,

Research proposal: Knowledge, Attitude and Practice of Eye Safety among Jua Kali Industry workers in Nairobi, Kenya (P661/12/2012)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and approved your above revised proposal. The approval periods are 12th March 2013 to 11th March 2014.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.

b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN-ERC before implementation.

c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.

d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.

e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period.

(Attach a comprehensive progress report to support the renewal.)

f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.

g) Submission of an executive summary report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

"Protect to Discover"
For more details consult the KNH/UoN ERC website www.uonbi.ac.ke/activities/KNHUoN

Yours sincerely

[Signature]

PROF. A.N. GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
    The Principal, College of Health Sciences, UoN
    The Dean, School of Medicine, UoN
    The Chairman, Dept. of Ophthalmology, UoN
    The HOD, Records, KNH
    Supervisors: Prof. Dunera Ilako, Dr. Sheila Marco

“Protect to Discover”
APPENDIX B: MAP OF STUDY AREA

Key: Kencom Building – Annotation A; Study area 1 - Red outline; Study area 2 - Green outline.
APPENDIX C: CONSENT FORM

Title: Knowledge, attitude and practice of eye safety among Jua Kali industry workers in Nairobi, Kenya.

Investigator: Dr A Mashep

Supervisors: Prof D Ilako

Dr S Marco

Address: (University of Nairobi, P.O. BOX 30197, 00100, Nairobi)

Contacts of lead investigator 0723-363360

Information to participants: the aim of this study is to find out what workers in the Jua Kali industry know, think and do about eye safety at work through a brief interview and nonparticipant observation that I request you to participate in. Whatever information you shall give shall be regarded with strict confidentiality, and will not be used in any way to jeopardize your work or in any other way other than the stated purpose. You are free to participate, to decline to participate, or to decline further participation during the course of the interview. Your participation does not expose you to any harm and there is also no benefit including compensation for your time. It you are in agreement with the conditions above and are willing to participate in this study, kindly append your signature below.

Participant’s signature____________________ Date______________________________

Investigator’s signature____________________ Date______________________________
FOMU YA OMBI LA RIDHAA

Lengo la hili uchunguzi ni kutaka kuelewa ni nini wafanyi kazi wa Jua Kali wanajua, wanafikiri na wanafanya kuhusu majeraha ya macho kazini. Tunakuomba utupe muda wako mdogo kushiriki kwa mahojiano. Yote utakayotueleza yatalindwa kamiliwa na hatatumiwa kwa njia yoyote kudhuru kazi yako au kutumiwa kwa njia yoyote isipokuwa kwa hili somo.

Uko huru kushiriki kwa uchunguzi huu, na pia uko huru kutoshiriki, au kutomaliza shirika katika mahojiano. Kama unakubaliana na hayo na ungependa kushiriki, tafadhali tia sahihi yako hapa chini.

Sahihi ya mshiriki___________________________ Tarehe___________________________

Sahihi ya mtafiti____________________________ Tarehe____________________________
APPENDIX D: DATA COLLECTION TOOLS

1. QUESTIONNAIRE.

Date ........................................ Q/No............................................

PART A: Demographic data

Initials __________________________

Age __________________________

Sex __________________________

Marital status __________________________

Approximate monthly income(Ksh)________

PART B: Training and work experience.

1. What is the highest level of education you have completed?
   1. No schooling [ ]
   2. Primary school [ ]
   3. Secondary school [ ]
   4. Vocational school [ ]
   5. College/university(certificate/diploma/degree conferred) [ ] _________________

2. How were you trained for the work you are now doing?
   1. Vocational school [ ]
   2. College/university [ ]
   3. By apprenticeship [ ]
   4. Self-taught [ ]
   5. Other (please explain)______________________________

3. What activities are you involved in daily? (tick all that apply)
   1. Hammering metal [ ]
   2. Welding [ ]
   3. Grinding metal [ ]
   4. Sanding [ ]
   5. Soldering [ ]
   6. Smelting [ ]
   7. Spray painting [ ]
   8. Battery check [ ]
   9. Others (name)______________________________________
4. How long have you worked in this industry?
   1. Less than 1 year [ ]
   2. 1 to 5 years [ ]
   3. 6 to 10 years [ ]
   4. 11 to 15 years [ ]
   5. 16 to 20 years [ ]
   6. more than 20 years [ ]

PART C: Past ocular history.

1. Have you ever had a work-related eye injury?
   1. Yes [ ]
   2. No [ ] go to 2.

2. Describe the last injury you had.
   Date of last work-related ocular injury ___________________________
   Eye(s) involved
   OD   OS   OU
   Circumstance of injury _______________________________________
   Nature of injury ____________________________________________
   What did you do
   Immediately________________________________________________
   Within 24 hours ___________________________________________

3. Did you visit a health facility?
   1. Yes [ ]
   2. No [ ] (go to Q6)

4. If yes, how many hours after the injury? ________________________

5. If not immediately, what was the reason for the delay?
   ___________________________________________________________

6. Was there a reason for not visiting a health facility?
   ___________________________________________________________

7. What was the outcome of the injury?
   ___________________________________________________________

8. Do you know a colleague who has suffered any work-related ocular injury?
   ___________________________________________________________
9. What was the outcome of their injury?____________________________

PART D: Knowledge and awareness.

1. Are you aware of any activities in your daily work that pose a risk of eye injury?
   1. Yes [ ]  2. No [ ]

2. Can you name any activities you or your colleagues perform that pose a risk of eye injury?
   1. Hammering metal [ ]  2. Welding [ ]
   3. Grinding metal [ ]  4. Sanding [ ]
   5. Soldering [ ]  6. Smelting [ ]
   7. Spray painting [ ]  8. Battery check [ ]
   9. Others (name)_______________________________________

3. Do you know how any of these activities can cause eye injury?
   Activity Injuy
   __________________________________________________________
   __________________________________________________________

4. Do you know how any of these injuries may be prevented?
   1. Through use of PPE [ ]
   2. Don’t know [ ]
   3. Others (please explain) _________________________________

5. What PPE would be the most suitable for the work you do? (If Yes to Q1)
   Activity PPE
   __________________________________________________________
   __________________________________________________________

6. Where did you first learn about PPE? (If answer to Q4=1)
   1. Newspapers/magazines [ ]  2. Radio [ ]
   3. Television [ ]  4. Teachers /lecturers [ ]
   5. Trainers /mentors [ ]  6. Health workers [ ]
   7. Colleagues  8. Others____________________

7. Do you feel well-informed about occupational eye safety?
   1. Yes [ ]  2. No [ ]
8. Do you wish you could get more information about eye safety?
   1. Yes [ ]  
   2. No [ ]

7. How best can this information be communicated to you and your colleagues?
   1. Newspapers/magazines [ ]  
   2. Radio [ ]  
   3. Television [ ]  
   4. Training institutions [ ]
   5. Others (please explain) ____________________________________________

PART E: Practice and health-seeking behaviour.

1. Do you own any PPE?
   1. Yes [ ] (go to 2)  
   2. No [ ]

2. What PPE do you own (Ask to see PPE)
   ______________________________________________________________________

3. Do you use any PPE?
   1. Yes [ ]  
   2. No [ ]

4. If yes, for what and how often do you use it?
   What _____________________________________________________________________
   How often (always, sometimes, never) _____________________________________________________________________
## 2. OBSERVATION SCHEDULE

<table>
<thead>
<tr>
<th>PERSONAL PROTECTIVE EQUIPMENT</th>
<th>YES</th>
<th>NO</th>
<th>ADDITIONAL COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Does the worker possess any PPE?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong> Is he/she using the PPE?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> Is the PPE appropriate for the task he is performing?</td>
<td></td>
<td></td>
<td>(Faceshield- splashes, dusts, with nozzle if handling chemicals, dusts Safety spectacles (+/- nozzle) - dusts, impact Safety goggles- projectiles, slug chips, splatter, splashes, impact Welding shield- IR, UV, Radiant light exposure, sparks, spatter, slug chips, impact Laser safety goggles- welding)</td>
</tr>
<tr>
<td><strong>4.</strong> Is he handling or wearing the PPE correctly?</td>
<td></td>
<td></td>
<td>(fitting properly, worn over relevant area to be protected, used at appropriate distance)</td>
</tr>
<tr>
<td><strong>5.</strong> Is the PPE in good working condition?</td>
<td></td>
<td></td>
<td>(no obvious breaks, cracks, pitted/scratched lenses, faulty/exposed wiring, multiple repair marks/improvisation)</td>
</tr>
</tbody>
</table>
3. **FOCUS GROUP DISCUSSION GUIDE.**

1. Do you feel that you are generally more likely to suffer injuries because of the nature of your work?
   - Why or why not?

2. What are some of the work-related injuries that concern you?
   - Can you rank them in order of the most to the least concerning?
   - How do you explain this ranking?

3. Do you ever worry about work-related eye injuries?
   - Why or why not?

4. Do you think you are more likely than the average person to suffer work-related eye injuries?
   - Why or why not?

5. What worries you most when you think about eye injuries and why?

6. Do you think work-related eye injuries are likely to be severe?
   - Why or why not?

7. What do you feel about the use of PPE?
   - Do you believe they are efficacious?

8. Are there times when you are more likely or less likely to use PPE?
   - What are these times when you are more likely or less likely?

9. Do you think you would be more likely to use PPE if it was provided rather than if you had to buy your own?

10. If you are performing a task that you think is hazardous, how do you protect your colleagues from injury?

11. What are some of the reasons you or your colleagues delay or fail to seek medical attention in the event of work-related ocular injury?
4. **KEY INFORMANT INTERVIEW GUIDE.**

1. Please describe how the Jua Kali sector came into existence.

2. How did the Kamukunji Jua Kali association get started?
   - What were the factors that prompted its formation?

3. How can a Jua kali worker join the association?
   - What are the eligibility criteria?
   - Are there any membership fees?

4. What are the benefits of being a KJKA member?

5. Is there a governing body that regulates activities in the sector?
   - Are there activities that are generally considered high risk?
   - Are such activities considered illegal?

6. Are you aware of any health and safety concerns of your members?
   - How are you addressing these?

7. Are you aware of any occupational health and safety laws?
   - What do you know about the occupational health and safety act?
   - How are you implementing it as an association, as an employer?

8. How are the majority of the Jua Kali workers employed?
   - How are they paid?

9. As employers, what arrangements have you made towards the occupational safety of your employees?
   - What happens in the event of a work-related injury in terms of time off to seek medical attention, the cost of treatment?

10. How would you describe the relationship between the Jua Kali sector and the government?
    - Are there specific ways you would like the government to help you to assure the occupational safety of your members?
PHOTOGRAPHS FROM THE STUDY SITES.

Photos 1,2: Overcrowding of workers in metal work sheds, as they hammer and forge scrap metal.
Photos 3,4: Improvised systems in the harsh outdoor environment.
Photos 5,6: Lack of PPE, and of appropriate work surfaces, faulty/makeshift tools, and crowding of workers.
Photos 7,8: Bystanders, lack of appropriate work surface with liquid spill during overhead work, and lack of PPE use.
Photos 9,10: Poor storage facilities with wires and scrap metal at entrance of the shed. Risk of injury to clients and passersby at the Gikomba metal works.
Photos 11, 12: Minors at the work place. Some of the finished products from recycled scrap metal made by the metal workers.