Photo stress recovery time and incidence of RTAs among commercial drivers in Bindura.

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A research dissertation submitted in partial fulfillment of the requirements of the Bachelor of Science Honors Degree in Optometry (HBScOpt)

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Research project

Declaration

Supervisor's Statement of approval

I, **Dr. Selassie Tagoh**, agree that I supervised this study conducted by Munashe Marufu and confirm that the project meets the standards for submission in partial fulfillment of the Bachelor of Science Honors Degree in Optometry (HBScOpt) at the Bindura University of Science Education.

Signature……………………….

Date…………………………….

Student's declaration

I, Munashe Marufu do hereby declare that this study is my work, done under my supervisor's guidance, submitted in partial fulfillment of the requirements for the Bachelor of Science Honor's Degree in Optometry at the Bindura University of Science Education.

Signature……………………..

Date ………………………….

Dedications

This work is dedicated to my fellow university mates and family.

Acknowledgments

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List of abbreviations

PSRT- Photo Stress Recovery Time

VID – Vehicle Inspection Department

TSCZ – Transport Safety Council of Zimbabwe

WHO – World Health Organization

BUSE – Bindura University of Science Education

ABSTRACT

Background: The photo stress recovery time test is a clinical technique used to test the functional ability of the macular. This results in a visual acuity decrease after exposure to light as the light bleaches the photoreceptors. Photo stress recovery time is used to differentiate post-retinal and macular abnormalities, whereby people with the macular disease tend to have longer photo stress recovery times whilst those with the optic nerve disease are not affected. It is independent of visual acuity, pupil size, and ametropia, but it increases with age. In drivers, flashlights from oncoming cars result in a transient drop in visual acuity for a duration dependent on the ability of visual pigment regeneration. This can affect driving at night and possibly lead to road traffic accidents (RTAs).

The study is to determine the photo stress recovery time for commercial drivers and its impact on road traffic accidents in Bindura.

Method: This is a cross-sectional descriptive study designed, accompanied by structured questionnaires to gather information from participants at the Bindura Vehicle Inspection Department and other various places. A routine clinical eye examination was conducted on every participant and photo stress recovery time was also done without spectacles. A sample of 250 participants enrolled were only commercial drivers with valid licenses. The test was conducted both monocularly and binocularly with a direct ophthalmoscope, a stopwatch, a pen-torch, lux meter, and a Snellen chart.

Results: The study found that 92.8% of the participants were males and most of them had a secondary school level of education (73.6%). Most of the participants had Class 2 driver's licenses (64.8%) and there were not officially registered. Most of the participants had good eyesight (70.4% and 63.2% did not complain of reduced distance and near vision, respectively), and only a few complained of mild glare sensitivity (49.2%) and photophobia (57.2%). There was a significant increase in photo stress recovery time with age (20-29years>15sec and 40-49years<15sec. There was no association between photo-stress recovery time, and the occurrence of road traffic accidents ($p=0.18$) and gender ($p=0.594$). Most road traffic accidents ($p<0.05$) were a result of machine failure and poor road structures.

Conclusion: Photo stress recovery time has no impact on the occurrence of road traffic accidents; however, it increases with increase in age. The prevalence of road traffic accidents

due to machine failure and poor roads needs to be addressed to improve the quality of life of drivers and their passengers.

Keywords: photo stress recovery time test, road traffic accidents

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter introduces the study of photo stress recovery time test and its impact on the incidence of road traffic accidents among commercial drivers in Bindura. It describes the background and justification for this study, defines the problem which influenced the researcher to research the area, describes the significance of this study concerning optometry, and concludes with definitions of terms to be used in this study.

1.2 Background of the study

According to Bishwash et al., (2020), the photo stress recovery time test is a psychophysical method in which prolonged exposure to light leads to insensitivity and loss of vision. This is because dark adaptation takes time to regenerate visual pigments, to restore visual sensitivity to its original state (Chidi-Egboka et al., 2016). The photo stress recovery time involves exposing the patient’s eye to light for a minimum of 10 seconds (monocularly) after taking their visual acuity according to Chidi-Egboka et al., (2016). The time taken for the patient to be able to read any three (3) letters above the best line of visual acuity is measured using a stopwatch, as claimed by Omokhua & George, (2010) is the recovery time. Recovery time is dependent on the time taken by the photoreceptors to re-synthesize the retinal pigment epithelium after bleaching, returning sensation according to Margrain & Thomson, (2002).

The photo stress recovery time is used to easily detect and distinguish the causes of reduced vision, measure, functional ability and performance of visual pigments, and monitor the progression of diseases such as Age-Related Macular Degeneration and Glaucoma as reported by Horiguchi et al., (1998). Some studies have shown that in patients with maculopathy when exposed to bright lights, vision recovery is very slow despite having normal visual acuity following Hammond et al., (2013).

Extended recovery time imposes severe danger to commercial drivers when an opposing car flashes bright headlights (Chidi-Egboka et al., 2016), this results in a dramatic drop in vision due to the light bleaching effect of the retinal pigments, leading to road traffic accidents.

Use of the road as a mode of transport is the most common and easiest worldwide according to Bener et al., (2009). Despite being the cheapest, it has been recorded to have a lot of accidents and injuries, especially in developing countries according to Hyder et al., (2012). Worldwide, the total number of road traffic accidents remains unacceptable, with at least 1.2 million lives lost per year reported by Peden (2004). Studies have proven that the effect of glare and field loss on drivers has increased the chances of road traffic crashes following Piyasena et al., (2021).

Road transportation looks at the system as a whole comprising of the road, road user, and vehicles. Zimbabwe is experiencing an increase in motorization due to emerging better ways of procurement and shipping in e-procurement according to Dzuke & Naude, (2015), while roads have deteriorated resulting in increased road accidents. In Zimbabwe, motorization appears to be increasing, while at the same time road traffic accidents are rising briskly due to deteriorated roads, traffic law violations, reckless driving, and damaged vehicles, with an 85% fatality rate reported by Muvuringi, (n.d.). Road transport safety is a shared responsibility among the following: government, law enforcers, and health professionals as claimed by Peden, (2004). Although drivers in Ghana are required to pass an eye test before being permitted to acquire a driver's license, many commercial drivers still drive with poor vision as reported by Boadi-Kusi et al., (2016), which is also applying to Zimbabwe. This is due to systemic flaws in Zimbabwe's government that permit some drivers to obtain licenses despite having poor vision as claimed by Mangwaya, (2022).

Despite the significant influence of photo stress recovery time in differentiating between retinal and post-retinal disease (Omokhua & George, 2010), its impact on RTAs is of major concern in this study.

1.2 Problem statement

WHO (2022) report, shows that road traffic deaths in Zimbabwe, among other neighboring countries, is very high with a mortality of 35 per 100 000 and also brings about the issue of unlicensed drivers as one of the causes of road traffic accidents. The impact of the slacked system on the road sector increases the risk of dangerous conditions on the roads according to Mangwaya, (2022). Most road traffic accidents occur due to a lack of standard infrastructures such as roads and bridges, lack of severe penalties, for lawbreakers for example speeding, and misjudgment of distance by the driver as reported by Gopalakrishnan, (2012). Driving with poor eyesight can potentially cause accidents due to insufficient testing of visual functions before acquiring a driver's license according to Mangwaya, (2022).

Oncoming car lights offer a serious annoyance to drivers and limit vision when driving at night. If one has underlying medical conditions like cataracts which produce glare, these difficulties are exacerbated according to Chidi-Egboka et al., (2016). When nighttime drivers are exposed to bright light, their vision is transiently reduced; in eyes with healthy macular and photoreceptor function, this is quickly restored. While it is known that these factors influence photo stress recovery time, they may also affect drivers' propensity to be engaged in RTAs while driving at night.

The main part of this study is to estimate photo stress recovery times for commercial drivers in Bindura and correlate those results with road traffic accident occurrences.

1.4 Aim of the study

To determine photo stress test recovery time among commercial drivers and its impact on road traffic accidents in Bindura.

1.5 Objectives

- To measure the normative photo stress recovery time among commercial drivers in Bindura- Zimbabwe.
- To determine any correlation between photo stress recovery time and the likelihood of RTAs occurrence among commercial drivers in Bindura.
- To determine any correlation between the driver's age and photo stress recovery time.

1.6 Significance of the study

The results of this study will help the transport and vehicle department understand how the photo stress recovery time test affects driving performance on the road. Additional tests that assist in decreasing the incidence of RTAs will be helpful given that the number of accidents is increasing on an annual basis. Currently, drivers in Zimbabwe must have a valid driver's license, be at least 16 years old, have at least five years of experience, and have their eyesight evaluated by being randomly instructed to read a license plate from a distance. Correcting eyeglasses are not prohibited according to the Constitution of Zimbabwe, (2013). According to Chidi-Egboka et al., (2016) drivers are required to have a visual acuity of 6/12 or better. If photo stress recovery time proves to be an important factor in the occurrence of RTAs, then we can recommend spectacles or spectacles with special coatings for drivers who may not even have refractive errors. This can help reduce the impact of glare and reduce RTAs.

1.7 Conclusion

The previous section focused on the research study's introduction highlighting the need for the study, its objectives, and its importance.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on a thorough assessment of the literature in investigating the effect of photo stress recovery time tests on road traffic accidents. It will include reviews of the literature from the entire world, Africa and Zimbabwe. Google Scholar, Pub Med, Research Gate, Newspapers, and the BUSE Digital Library are some information sources that were used to find information from books, articles, and journals. Several significant search terms were utilized, including "photo stress recovery time," "road traffic accident rate," "Bindura road traffic accidents," and many others.

2.2 Global Review

This section focuses on research done on continents other than Africa. The review detailed the goals of the researchers, the individuals who participated in their investigations, and their conclusions.

2.2.1 Photo stress recovery time

Photo stress is a clinical technique that involves exposing the eye to intense light, typically using an ophthalmoscope, and the amount of time it takes for visual acuity to return is recorded, it is used to distinguish retinal and post-retinal disease in which macula diseases are indicative by a delayed recovery time as reported by Margrain & Thomson, (2002). According to Chande et al., (2020) photo stress recovery time is used to analyze macula function specifically the central sensitivity function in individuals who tested negative for diabetes mellitus. The decrease in visual acuity is due to the photoreceptors' bleaching effect which wears off depending on the rate of the photo-pigment regeneration according to Margrain & Thomson, (2002). PSRT varies with age, eye disease for example glaucoma, and medications like alcohol according to Margrain & Thomson, (2002). Some studies do agree, like Omokhua & George, (2010), that, there is a significant relation between PSRT and age.

Severin et al., (1966) stated that there is a prolonged PSRT result with an increase in age, however it disapproves with Bishwash et al., (2020) who reported that there is no association between the two variables. Therefore, this gives an uncertain relationship between PSRT and age.

Glaser et al., (1977), Natsikos & Dean Hart, (1980), and Stringham et al., (2016) all agree that diseases like retinitis pigmentosa, macula drusen, cystoid macular edema, and central serous retinopathy delay PSRT. In a general eye exam, the PSRT test is often not undertaken because the methodology is not standard and lacks sources of variability according to Margrain & Thomson, (2002). According to Natsikos & Dean Hart, (1980), PSRT for two eyes is generally accepted to be the same for an individual, differences arise from the use of various procedures, although they rarely last longer than 80seconsds. The PSRT test was performed using an ophthalmoscope pointed into one eye, while the other was occluded for 30 sec at 5cm nasally, and recovery time was then recorded after one participant read the Pelli-Robson chart, according to Chande et al., (2020). Natsikos & Dean Hart, (1980) used a Zeiss fundus camera, and Glaser et al., (1977) used a pen torch for 10 seconds to generate photo stress stimulus. Sherman & Henkind, (1988) to standardize the PSRT test introduced a scotometer as a measurement tool to determine the effect of PSRT on birth control effects.

Quantifying PSRT is crucial, especially at night when light exposure might temporarily impair vision, because dark conditions lengthen reaction and stopping time as reported by Alzahrani et al., (2019). Blue-blocking lenses have a lot of benefits, however, they impair contrast sensitivity and reduce PSRT, according to Alzahrani et al., (2019). Alzahrani et al., (2020) reported an increased photo stress recovery time with aging. According to Chande et al., (2020) the reduction in contrast sensitivity function also delays PSRT in patients with pre-diabetes mellitus, which can be used as an early diagnosis of diabetes mellitus and microvascular changes.

2.3 African review

This section explores studies undertaken in Africa; it comprises of the objectives of the research, the subjects that were part of it, the conclusions are drawn from the findings, and the participants in the study.

2.3.1 Photo stress recovery time

In Nigeria, the photo stress recovery time test was the subject of two investigations, which concluded that it was a method for evaluating macular function that is psychophysical and results from exposure to light that bleaches photoreceptors according to Chidi-Egboka et al., (2016) and Omokhua & George, (2010). Extended photo stress recovery time is due to a setback in the regeneration of photoreceptors as stated by Chidi-Egboka et al., (2016) who also reported that the test is mainly to differentiate the cause of decreased visual acuity that could be due to lesions on the optic nerve or from the macular disease. Omokhua & George, (2010) stated that the test also assesses the performance of rods and cones. A study was conducted to determine the effect of age on PSRT randomly on a sample aged between 11 years and 70 years in Nigeria Omokhua & George, (2010) and the participants were cleared of abnormalities related to the eyes. A pen torch was used to shine light into the eye for 10 sec; when the individual was able to distinguish either one or two optotypes above the best line of visual acuity on the Snellen chart or tumbling E, the recovery time was immediately recorded according to Chidi-Egboka et al., (2016) and Omokhua & George, (2010). Participants using spectacles had to lower them to cut off reflections and then immediately place them back after the light exposure as reported by Chidi-Egboka et al., (2016).

According to Omokhua & George, (2010) PSRT results distribution was positively skewed, with males having a high PSRT of 25.77±12.49 sec compared to females with 25.04 ±11.83sec. Omokhua & George, (2010) reported that regaining vision and contrast sensitivity after light exposure is dependent on the functional relationship between photoreceptors and retinal pigments epithelium. The broad variation in PSRT results was because of different methods used to assess visual acuity, and light intensity, including the population used and the marked end point as reported by Omokhua & George,(2010). The researcher had to grasp the top eyelid to avoid blinking to minimize inaccuracies, and the pen torch batteries had to be charged after every 15 participants to maintain the same level of intensity as claimed by Omokhua & George, (2010). 200 participants took part in the study and those with ages above 40years showed significantly high PSRT results providing an association between PSRT and age as reported by Omokhua & George, (2010).

Chidi-Egboka et al., (2016) conducted a research to assess the distribution of delayed PSRT about age, visual function, and driving safety due to the increase in road traffic accidents over the past years in Nigeria. According to Chidi-Egboka et al., (2016), Bruch's membrane (choroid), which is independent of the optic nerve, is responsible for the regeneration of vision following light stress. Glaucoma, which affects ganglion cells, can also contribute to a longer recovery process following Chidi-Egboka et al., (2016). The study conducted used the same method as the Glaser technique stated by Glaser et al., (1977), and revealed that age, driving safety and visual field do not correlate with PSRT, however, there is a relationship between visual acuity and color recognition.

2.4 Road traffic accidents and driving requirements review

The ability of a driver to correctly judge distance is an appreciation of stereopsis which is essential for driving safety; drivers with diminished vision tend to have challenges overtaking, estimating distance, and changing lanes resulting in road traffic accidents (RTAs) as reported by Boadi-Kusi et al., (2016). Driving is a very complicated task that takes up 95% of all senses, mostly considered a visual task. Hence every country has its standard driving requirements for both private and commercial drivers according to Adewole et al., (2021). In the United States, there are strict standard visual requirements for commercial licensing, and restrictions are based on vision test outcomes following Steinkuller, (2010). Zimbabwe's standard requirements for commercial driving include a valid driver's license, a minimum of 25 years of age with 5 years' experience behind the wheel, authorization of route from police, and a medical report from a general practitioner according to the Constitution of Zimbabwe.

For one to get a driver's license they are required to have good visual acuity and a normal field of view (Chidi-Egboka et al., 2016). Some studies have reported that people with poor visual functions are less likely to be involved in accidents, however, other visual impairments can influence accidents according to Mäntyjärvi et al., (1999). Refractive error is the most common eye problem which is associated with poor vision, in which poor eyesight is associated with RTAs following Kumar et al., (2022). A large number of people in Zimbabwe have an uncorrected refractive defect, which may be readily fixed with simple, inexpensive eyewear, but their services are unavailable for correction as reported by Tagoh et al., (2020).

A population of 1.2 million has been reported to have died from road traffic accidents and injuries, (Peden, 2004). The Transport Safety Council of Zimbabwe (TSCZ) produced statistics showing trends of road traffic accidents, there was a rapid increase in road traffic fatalities of 35% between 2010 which is approximately 1300 casualties, and 2000 casualties in 2019. Zimbabwe is reported to have a rate of 20.8% road traffic accidents which is very high and has claimed precious lives and destroyed properties worth millions of dollars as reported by Mangwaya, (2022). Other studies have reported that many drivers in Harare are short-sighted and this has resulted in many road traffic crashes as reported by (Tsiko, 2018). According to the Transport Safety Council of Zimbabwe, the causes of road traffic accidents are congestion on narrow roads, disregarded road rules and lack of care between two parties that is the driver and pedestrian, negligence, driving under the influence of alcohol, and dilapidated roads. According to Chidi-Egboka et al., (2016) there was no association between the incidence of RTAs and PSRT using the Chi-square test. Since glare bleaches the photoreceptors and reduces the ability to recognize objects it can cause road accidents (J et al., 2002).

2.5 Conclusion

The literature clearly shows that age, eye diseases, and medication affect photo stress recovery time, but the studies are few. A delay in PSRT is very dangerous to the driver since it can lead to accidents, while Zimbabwe has a record of a high rate of RTAs. The effect of photo stress on the population recuperation time has not been studied in Zimbabwe, according to studies. This study will broaden the body of knowledge in Zimbabwe and help the profession of optometry gain broader acceptance. This study will contribute to the body of information or research evidence in Zimbabwe and aid in the development of future policy directives intended to lower RTAs on Zimbabwean roads.

CHAPTER 3

METHODOLOGY AND MATERIALS

3.1 Introduction

This chapter outlines the research strategy used to estimate the time it takes for commercial drivers in Bindura to recover from photo stress. This included information about the study's design, sample and sampling method, inclusion and exclusion criteria, study instrument, strategy for the data collection process, and the technique used for data analysis. The ethical clearance required for the study's ethical conduct is also included in this chapter.

3.2 Study setting

The study was carried out at the Bindura Vehicle Inspection Unit, Bindura Winders, a few small businesses that moved mining ores around the town, and other modestly sized established locations that dealt with moving people from one location to another. The location was Bindura, which is 87 kilometers to the northeast of Zimbabwe’s capital city of Harare.

3.3 Study design

A descriptive cross-sectional design was used for this investigation. A cross-sectional descriptive study design is a form of observational study that analyses data obtained from a population, it is mostly used because it is quick, easy, and inexpensive to carry out according to Setia, (2016).

3.4 Study period

The study was conducted from the end of July 2022 to September 2022.

3.5 Study population

The study populations were Bindura commercial drivers registered and unregistered with the Council of Zimbabwe in Bindura.

3.6 Sampling method

The study participants were selected through a purposive sampling technique. Participants who met the inclusion criteria and consented to participate in the study were selected until the required participants were reached.

3.7 Study sample

The sample size was calculated using Slovin's formula below:

$$n=\frac{N}{I+Ne^2}$$

n=sample size

N=Total number population of commercial drivers in Bindura (600 estimate)

e=margin of error

$$n=\frac{600}{1+(600(0.05)(0.05)}$$

n=240

The study had a minimum target of 240 participants for the research.

3.8 Inclusion criteria

1. Participants, who are commercial drivers, had driver's licenses.

3.9 Exclusion criteria

1. Participants who will be unwilling to participate.

2. Drivers that used sleeping medication or have difficulties sleeping.

3.10 Study instrument

A handheld ophthalmoscope was the research instrument adopted for the study. The following steps were taken to determine the photo stress recovery times.

1. Introducing the participant and the researcher.
2. The individual receives a thorough description of what will occur throughout the photo-stress recovery examination, if he/she consents the researcher proceeds.
3. Compile the participant's medical and driving history anonymously.
4. Use a PD rule to measure and record the far and near pupillary distances.
5. The participant is told to place himself/herself 4 meters away from the Snellen chart and read the letters while their left eye is covered.
6. After recording this, the individual is told to look directly into the light for 10 seconds, during which time the macula is exposed to light.
7. The patient is told to read any three letters that are three or more above the line of best visual acuity as soon as the light is removed.

NB: Participants who use eyeglasses are encouraged to take them off before having light shone into their eye(s).

8. The participant's time reading the letter on the chart immediately following light exposure to the eye is timed using a stopwatch.

NB: Record and repeat the process when both eyes are open and with the left eye.

9. Take notes, and repeat the process while both eyes are open.
10. The internal and external structures of the eye are examined with an ophthalmoscope, and this is also documented.
11. The pen-intensity torch is checked using a lux meter, and after using it on 15 subjects, the battery is recharged.

3.11 Data collection

A four-section questionnaire was used to gather the data. The participants' demographic information was collected in the first part of the survey, which was also self-administered. The participants' reports of ocular symptoms were collected in the second section, driving-related questions were asked in the third section, and statistical variables were measured and recorded in the final section.

3.12 Data analysis

Data collected from the participants was analyzed using IBM Statistical Package for Social Sciences (SPSS) version 24 and JASP [JASP-Team, 2022]. The data entered into these packages was computed in frequencies, percentages, and proportions. The Chi-square test was performed to compare variations in PSRT and other variables such as gender and age groups. They were also used to indicate where there was a substantial significant difference between the variables.

3.13 Ethical consideration

Ethical approval was obtained from the Bindura University of Science Education Ethics Committee with approval number 0027/2022. An authorization letter was also presented from the Ministry of Transport and Infrastructures Development. To avoid injury to the participants and curb the spread of Covid-19, ethical considerations were followed and thorough sanitization of the workplace was done respectively. Participation in the study was not compulsory and participants were free to leave at any moment; the participants were given informed consent which had all descriptions of the study. Information of the participants was anonymized to ensure the privacy and confidentiality of the data collected. See **Appendix 1** and **Appendix 2**.

CHAPTER 4

RESULTS

4.1 Introduction

This chapter presents the results of the analysis conducted in the research on photo stress recovery time and its influence on the incidence of RTAs among commercial drivers in Bindura. The chapter presents the demographic characteristics of the participants, distribution of photo stress recovery time, and significance testing to determine the association between the variables measured. The results are presented in line with the study objectives with the use of tables and graphs.

4.2 Demographic characteristics of commercial drivers

A total of 250 commercial drivers took part in the study and were aged between 22 and 67. Overall 232(92.8%) of the participants were males and 18(7.2%) were females. The mean age for participants was 38.28±10.026. Chi-square test was conducted to determine the association between PSRT and gender and showed that there was no such association. X^2 (4, N = 250) = 2.785, p = 0.594, V=0.573)

The bulk of the participants was between the ages of 30-39years (n=84, 33.6%), followed by 40-49years (n=65, 26%) and those <29 (n=64, 25.6%). There was a significant gender difference (p<.001) and age group (p<0.05) distribution among the participants. Of the participants, most had secondary school qualification (n=184, 73.6%) followed by tertiary (n=37, 14.8%), vocational (n=18, 7.2%), the least was primary education (n=11, 4.4%) and there was hardly anyone without any form of education. Most of the participants had 15 years (24.8%) and 10 years (24.4%) of experience behind the wheel and the majority had Class 2 (64.8) driver's licenses **Table 4.4. Table 4.1** shows the distribution of demographics of the participants in the stud**y.**

Table 4.2: Demographics profile of the commercial drive

Variable	Level	N	Frequency	Percentage	Proportion	P-value
Age groups	≤ 29	250	64	25.6	0.256	0.019
	30-39	250	84	33.6	0.336	<.001
	40-49	250	65	26.0	0.260	0.013
	50-59	250	27	10.8	0.108	1.000

	≥60	250	10	4.0	0.040	1.000
Gender	Male		232	92.8	0.928	1.000
	Female		18	7.2	0.072	<.001
Level of education	Primary	250	11	4.4	0.044	1.000
	Secondary	250	184	73.6	0.736	<.001
	Tertiary	250	37	14.8	0.148	1.000
	Vocational	250	18	7.2	0.072	1.000

4.3: Mean distributions

Table 4.3.1: Summary statistics of variables measured.

Variable	**N**	**Minimum**	**Maximum**	**Mean**	**Std. error of the mean**	**Standard deviation**
PD at near	250	59	71	65.532	0.149	2.360
PD at far	250	62	74	68.388	0.144	2.283
PSRT OD	250	4	26	15.044	0.261	4.127
PSRT OS	250	5	29	14.999	0.282	4.457
PSRT OU	250	3	16	8.799	0.153	2.413
VA@ near OD (logMAR N)	250	0.10	0.80	0.286		0.219
VA @ near OS (logMAR N)	250	0.10	0.80	0.286		0.224
VA @ near OU (logMAR N)	250	0.10	0.80	0.282		0.219
VA OD far (logMAR N)	250	0.00	1.00	0.090		0.146
VA OS far (logMAR N)	250	0.00	0.60	0.084		0.124
VA OU far (logMAR	250	0.00	0.60	0.075		0.112

N)						

The maximum and minimum pupillary distances at far were 74±2mm and 62±2mm and at near were 71±2mm and 59±2mm respectively. The average photo stress recovery time for the right eye was 15.04±4.10sec; 15.00±4.50sec left eye and 8.80±2.40sec both eyes. The mean near visual acuity for the right and left eye was 0.286±0.224logMAR and for both eyes was 0.282±0.219logMAR. The mean distance visual acuity for the right eye was 0.09±0.146logMAR; 0.084±0.124logMAR left eye and both eyes were 0.075±0.112logMAR.

The average PSRT results were highest among 50-59years, age groups with 16.48±4.60sec left eye, 16.50±3.90sec right eye, and 9.67±2.50sec for both eyes. The Chi-square test results show that there was a statistically significant difference between age groups and PSRT measured for the right eye ($p = 0.042$) but no association was observed for the left eye (p=0.446) and both eyes (p>0.05) shown in the table below.

Table 4.3.2: Association between age, age groups, and PSRT

PSRT	**Chi-square statistic(age groups)**	**Chi-square p-value (Age groups)**	**Chi-square statistic (age)**	**Chi-square test (age)**
OD	32.432	0.042	174.828	0.002
OS	32.698	0.446	187.981	0.733
0U	16.166	0.055	114.739	0.035

There is a slight increase in PSRT with age as depicted in the bar graph.

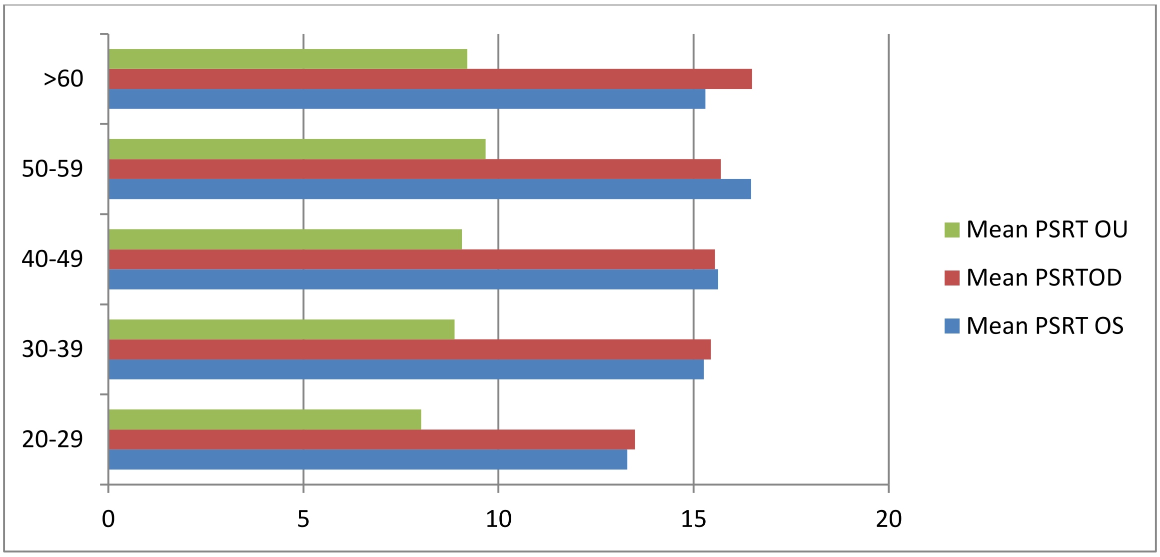

Figure 4.1: Bar graph showing how PSRT changed between age groups.

4.4 Severity of ocular symptoms reported by the commercial drivers

Half of the population that participated in the study reported moderate itchiness (n=125, 50%) followed by 95(38%) who did not experience any itchiness. Most of the participants observed glare though only mild cases (n=123, 49.2%), and 18 (7.2%) reported moderate glare. Many of the participants could comfortably see both at a distance (n=158, 63.2%) and near (n=176, 70.4%) respectively, these were participants with no complaints in terms of their ability to see. 143 (57.2%) participants were photophobic, followed by 75 (30%) with no problems with light sensitivity. **Table 4.3** shows the proportions of severity levels of ocular symptoms reported by participants**.**

Variable	**Level**	**N**	**Frequency**	**Percentage**	**Proportion**	**P-value**
Itchy eyes	None	250	95	38.0	0.016	1.00
	Mild	250	26	50.0	0.104	1.000
	Moderate	250	125	10.4	0.500	<.001
	Severe	250	4	1.6	0.380	<.001
Foreign body sensation	Severe	250	1	0.4	0.004	1.000
	Moderate	250	13	5.2	0.052	1.000
	Mild	250	69	27.6	0.276	0.190

	None	250	167	66.8	0.668	<.001
Red eyes	Severe	250	4	1.6	0.016	1.000
	Moderate	250	7	2.8	0.028	1.000
	Mild	250	57	27.6	0.276	0.809
	None	250	182	72.8	0.728	<.001
Watery eyes	Severe	250	0	0	0	
	Moderate	250	9	3.6	0.036	1.000
	Mild	250	74	29.6	0.296	0.056
	None	250	167	66.8	0.668	<.001
Glare	Severe	250	0	0	-	-
	Moderate	250	18	7.2	0.072	1.000
	Mild	250	123	49.2	0.492	<.001
	None	250	109	43.6	0.436	<.001
Reduced distance vision	Severe	250	2	0.8	0.008	1.000
	Moderate	250	25	10.0	0.100	1.000
	Mild	250	65	26.0	0.260	0.381
	None	250	158	63.2	0.632	<.001
Reduced near vision	Severe	250	1	0.4	0.004	1.000
	Moderate	250	7	2.8	0.028	1.000
	Mild	250	66	26.4	0.264	0.327
	None	250	176	70.4	0.704	<.001
Photophobia	Severe	250	8	3.2	0.032	1.000
	Moderate	250	24	9.6	0.096	1.000
	Mild	250	143	57.2	0.572	<.001
	None	250	75	30.0	0.300	0.042
Headaches	Severe	250	0	0	-	-
	Moderate	250	4	1.6	0.016	1.000
	Mild	250	79	31.6	0.316	0.011
	None	250	167	66.8	0.668	<.001

4.5 Behavioral attributes of commercial drivers.

Overall, 237(94.8%) of the commercial drivers had a valid license and 13 (5.2%) did not have one although they were aware that driver's licenses are mandatory requirements for every driver in the country. 62(24.8%) of the participants had 15years of experience followed by

61(24.4%) with 10 years of experience behind the wheel. Class 2 (n=162, 64.8%) driver's license was the most common among the drivers. A lot of the drivers did not have their eyes tested (n=154, 61.6%) before license issuance and more than half (n=148, 59.2%) did not renew their license upon expiration. Results indicate that 107(43.3%) of the drivers tested were involved in accidents in the past and the major causes of the accidents were machine failure (n=33, 30.8%) followed by the dazzling light (n=29, 27.1%) and overloading (n=27, 25.2%). Only a small group of 88(35.2%) participants, wore spectacles, and the main reason why these drivers wore glasses was to help them with near work/reading (n=50, 56.8%). This is shown in **Table 4.5.**

Table 4.5: Assessment frequency of behavioral attributes of commercial drivers

Question	Level	N	Frequency	Percentage	Proportion	P-value
Do you have a license?	No	250	13	5.2	0.052	1.000
	Yes	250	237	94.8	0.948	<.001
How long have you been driving?	5 years	250	57	22.8	0.228	0.809
	10 years	250	61	24.4	0.244	0.611
	15 years	250	62	24.8	0.248	0.553
	20 years	250	46	18.4	0.184	0.995
	>20 years	250	24	9.6	0.096	1.000
What type of class do you have?	None	250	17	6.8	0.068	1.000
	Class 1	250	45	18	0.180	0.997
	Class 2	250	162	64.8	0.648	<.001
	Class 4	250	26	10.4	0.104	1.000
Did you have your eyes tested before license issuance?	Yes	250	96	38.4	0.384	1.000
	No	250	154	61.6	0.616	<.001
When did you renew your	Never	250	148	59.2	0.592	<0.001

license?						
	1 year ago	250	61	24.4	0.244	0.611
	2years ago	250	32	12.8	0.128	1.000
	More than 3 years ago	250	9	3.6	0.036	1.000
Were you referred for an eye test?	Yes	250	69	27.6	0.276	1.000
	No	250	181	72.4	0.724	<.001
If you did, did you go?	Yes	250	55	22	0.220	1.000
	No	250	195	78	0.780	<.001
Have you worn glasses before?	No	250	162	64.8	0.648	<.001
	Yes	250	88	35.2	0.352	1.000
Why did you wear them?	For sight/vision	88	18	20.5	0.205	0.867
	Near work	88	50	56.8	0.568	<.001
	Fashion	88	12	13.6	0.136	0.997
	Block excess light from the sun	88	7	8.0	0.080	1.000
	Other	88	1	1.1	0.011	1.000
Were you involved in an accident?	Yes	247	107	43.3	0.433	0.985
	No	247	140	56.7	0.567	0.021
What was the cause of the accident?	Skid and road surfaces	107	2	1.9	0.019	1.000
	Difficulty seeing road signs	107	11	10.3	0.103	1.000
	Lack of proper judgment	107	3	2.8	0.028	1.000

	Dazzling light	107	29	27.1	0.271	0.342
	Defective light	107	2	1.9	0.019	1.000
	Overloading	107	27	25.2	0.252	0.515
	Machine failure	107	33	30.8	0.308	0.101

The study did not reveal any association between photo stress recovery time and the occurrence of RTAs. This is demonstrated by the fact that Chi-square test statistics are low and this result is confirmed by a weak Cramers *V* correlation coefficient, (X^2 (4, N = 250) = 6.28, p=0.18, *V* =0.16). Additionally, there was no statistically significant association between PSRT and reports of glare, (X^2 (8, N = 250) = 11.014, *p*=0.201, *V*= 0.201).

4.6 Conclusion

The main results of the research are that there is no association between the photo stress recovery time test and the likelihood of getting involved in RTAs among commercial drivers in Bindura-Zimbabwe. The age of participants in the study ranged from 22 to 67years. The majority had secondary school level education 184 (73.6%). Among the drivers tested, 232 (92.8%) were males and 18(7.2%) were females. The majority of the population had drivers' license 237(94.8%), Class 2 allocation 162(64.8%) with 15 years 162(64.8%) of experience of driving. More than half of the participants 154(61.6%) did not go through an eye examination before acquiring their driver's license and 69 subjects reported that they were referred for an eye examination but only 55 admitted that they did go to have their eyes tested following the referral. There is a slight increase in PSRT results with increasing age**.**

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter presents a discussion of the findings of the research. The discussion is structured to address the main objectives of the study such as demographics of commercial drivers, followed by photo stress recovery time among commercial drivers, then the relationship between PSRT and occurrence of RTAs, and lastly the correlation between drivers' demographics and PSRT. These objectives are discussed in the context of similar studies that have been conducted in the past.

A cross-sectional study was conducted that used a sample of drivers purposively selected from the commercial vehicle stations in Bindura-Zimbabwe. Overall, the results of this study show that PSRT among the sample tested is low compared to other similar studies. PSRT is associated with aging but does not affect the incidence of RTAs among commercial drivers in Bindura.

While it is estimated that about 600 drivers are operating commercial vehicles in Bindura-Zimbabwe, the sample included in this study is far less than the estimated number, this was because many of the commercial drivers operating in this community are not legally registered, thus accounting for the low number of drivers willing to participate in the study for fear of being found not registered. This resulted in low turnout of participants in our study. Nevertheless, it appears this small sample size is typical among similar studies in Africa. In a similar study in Nigeria, Ilorin Metropolis, done to assess the macula function using the PSRT test technique, over 4729 commercial drivers were officially registered but only 327 subjects were available to participate in that study Chidi-Egboka et al., (2016).

Also, previous studies used different sampling methods to recruit participants, compared to the current study; however, the mean age of participants tested was similar. The present study had participants aged between 20-64years with a mean of 38.28±10.03years while a similar study in India with a larger sample of 641 participants had an age range between 8 and 70years and an average age of 32.04±15.80years, Bishwash et al., (2020). While the mean age between the present study and that of previous study from India are almost similar, they differed in the age range of participants (present study 20-64years, the previous 8-70 years). The age of participants is important because if a sample includes more younger participants, this may influence the overall PSRT estimate since younger people have smaller PSRTs.

In the study by to Chidi-Egboka et al., (2016), participants were aged between 20-70 years with a mean age of 46±10.13years and most were from the 40-59years (63.7%) age group.

Previous studies have reported variable mean PSRT results, for example Chidi-Egboka et al., (2016) reported, Glaser et al., (1977) reported 27±11sec, and Omokhua & George, (2010) reported 22.21±5.70sec. In this study, an average of 15.02±4.40sec was recorded which is the lowest compared to other studies which have been conducted in the past. Like Chidi-Egboka et al., (2016), the present study used the same method as Glaser because it is simple and easy to execute however, a disadvantage of the ophthalmoscope could be that it did not produce enough light intensity to bleach the photoreceptors as noted by Hollins & Alpern, (1973) since the rods and cones are dependent on light intensity. Like Chidi-Egboka et al., (2016) perhaps the huge difference in means recorded in this study compared to previous studies could also be because participants in the present study had overall smaller pupil sizes which did not allow enough light to enter the eye and reach the retina to bleach the photoreceptors. It is already known that pupil size reduces with increasing age, most of the participants in the present study were between 40-49years age group and likely this might have influenced the low PSRT estimate.

All drivers who operate commercial vehicles were included in the study and the study did not exclude those with poor visual acuity, refractive errors, and underlying diseases such as glaucoma. While this is contrary to the case in a study conducted by Margrain (2002), we did not exclude drivers on this ground because we wanted to capture the true nature of PSRT estimates that will reflect the true visual function of the driving population in Bindura. The study by Margrain & Thomson, (2002) had a different aim which resulted in shorter PSRT (12.01±4.01sec) due to the limited sample and wide age range. The PSRT recorded here is 15.044±4.127sec, which is nearly identical to the PSRT in the earlier study.

Previous studies included more female participants (50.23%) than male participants (49.77%), which differ from our study which has more male participants (92.8%) than female participants (7.2%). This gender difference is largely attributable to the belief in Zimbabwe communities that commercial driving is a reserve of the male gender as reported in previous studies in other populations (Granié & Papafava, 2011). While the results show that there is no association between PSRT and gender ($p>0.05$), and visual acuity ($p=0.54$). There is however a statistically significant association between age groups and the measured PSRT ($p<0.05$). These results are consistent with results in previous studies reported by Loughman et al., (2014).

According to reports from studies conducted by Loughman et al., (2014), there is no association between PSRT and gender ($p>0.05$). This has been confirmed here where results show no association between PSRT and gender ($p=0.594$). Moreover, the proportions of female participants in previous and present studies were low and this could be the reason for the non-significant associations recorded.

Some studies have shown that flashes of light from oncoming vehicles in road setups induce glare which impairs vision by reducing the ability to identify objects both near and far especially in elderly people (J et al., 2002). Skaar et al., (2010) discovered that decreased visual attention was associated with increased glare sensitivity, which in a traffic situation can result in accidents. However, close to half of participants in our study (n=123, 49.2%) reported mild glare sensitivity, but the majority of them had no trouble seeing both far and close objects.

Other studies have shown that drivers with high glare sensitivity are usually at high risk to be involved in road traffic crashes since glare induces delayed PSRT as reported by Babizhayev, (2003). According to (Plainis et al., 2006), nightfall is believed to induce behavioral changes in drivers' performance resulting from an increase in fatigue, hence drivers tend to have fewer driving hours during dark hours, C et al., (2001). The increase in glare sensitivity, increase glare recovery (delay PSRT) (Chidi-Egboka et al., 2016), therefore increasing reaction time and stopping distance according to Plainis et al., (2006).

However in a study done by Chidi-Egboka (2016) in Nigeria, they revealed that there was no significant relation between PSRT and RTAs ($p=0.307$ right eye, $p=0.266$ left eye), the authors explained this to be due drivers tending to drive less at nightfall Chidi-Egboka et al., (2016). The present study confirms this result, there is no association between PSRT and the incidence of RTAs ($p>0.05$). It is likely drivers in this study adopted a similar behavior. Although our questionnaire did not directly probe this, it is possible that drivers in Bindura tend to avoid nighttime driving because of glare hence they are less likely to get involved in an accident because of glare sensitivity on the road. Hence a minority of theme reported ever involved in an accident. This can be deduced from the scarcity of commercial transport during these times.(Boadi-Kusi et al., 2016), also discovered that there is no association between road traffic occurrence and refractive error and stereopsis. However, they showed that there was an association with color vision. In our present study refractive error, color vision, and stereopsis were not studied.

In this study, we report a statistically significant difference in PSRT with respect to the different age groups tested. This association is true for the PSRT measured for the right eye (p=0.002) and both eyes (p=0.035), but not for the left eye (p=0.733). Our results confirm findings in previous studies showing that PSRT increases with an increase in age. Specifically results here show that the average PSRT results in the 20-29 years age group was 13.50sec while those in the 50-59years age group was 15.70sec. This result is consistent with the results of a study by Bishwash et al. (2020).

According to Omokhua & George (2010), PSRT increases with age because the photoreceptors take a longer time to return to their previous vision in old age. Bishwash et al., (2020), noted that there was an increase in PSRT between the age of 30 and 60. Therefore, both of these studies showed that there is a relationship between PSRT and age. The increase in PSRT across the age groups indicates the deterioration of photoreceptors with age, reducing the functionality of RPE that occurs due to aging according to Omokhua & George, (2010).

Omokhua & George, (2010) noticed that most changes in PSRT occurred in age groups between 51-60years (30.52%) and 61-70 years (40.89%) and they coincide with presbyopia which starts at the age of 40 according to Mvogo et al., (2019). Even our current study had the most changes between age groups 50-59 and >60.

According to Bishwash et al., (2020) children tend to have low PSRT results (9.82 seconds for males) because their photoreceptor cells in the RPE will still be functioning very well. However in the elderly, with aging, photoreceptors decrease in number, resulting in decreased RPE functionality producing high PSRT Salvi et al., (2006). Aging also results in a decrease in visual acuity and contrast sensitivity, and it increases dark adaptation threshold frequency which results from the degeneration of rods and cones Chilaris, (1962). Therefore the higher PSRT results from other studies could also be due to underlying retinal diseases which could have been missed during the eye examination, it is that case that just like some studies, this study did not use a slit lamp bio-microscope to examine the fundus (Bishwash et al., 2020). The study by Chidi-Egboka et al., (2016) is similar to this present study. Although this study did not employ slit lamp bio-microscopy, ophthalmoscopy was conducted to assess the retina for any abnormality hence the results reported here are unlikely to be affected by missed retinal abnormalities.

5.2 Conclusion

The study included significantly more men than women, which support gender stereotype in commercial driving and in general. Most of the participants had a secondary school level education. Most accidents were reported to occur at night; hence most drivers have limited night driving hours. The results of the investigation revealed that while age and PSRT are related, gender and PSRT do not correlate. Road traffic accidents in Bindura are primarily caused by equipment failure and degraded road structures; the photo stress recovery time is not related to their incidence.

CHAPTER 6

CONCLUSION AND RECOMMMENDATIONS

6.1 Conclusion

Since most of the drivers had never gone through an eye examination and the probability that one could have vision problems is significant. Because driving is regarded as a masculine occupation in our culture, there are more men than women who drive. Most of the commercial drivers were not officially registered and some did not even qualify to be commercial drivers because they did not meet the standard requirements. The majority of the drivers who could not see both at near and distance also complained of photophobia and glare. This study proved that the photo stress recovery time test did not have any impact on the occurrence of road traffic accidents in Bindura. The major causes of road traffic accidents were machine malfunction and deteriorated road structures.

6.2 Study limitations

The sample size of the study is only a small proportion; therefore the study has limited generalisability to entire Zimbabwe. Lack of portable equipment to move around to various stations to test drivers at different locations.

6.3 Recommendations

Given that driving consumes 95% of a person's senses, eye examinations should be made more accessible and drivers should be made aware of the significance of eye health. The Southern African Development Community, medical requirements for drivers and the definition of visual standards should be clearly defined for both private and commercial drivers by the Vehicle Inspection Department. Before pre-licensing testing, they should make sure that every commercial driver undergoes a thorough eye check-up, and they should train their Vehicle Inspection Department employees to do a general eye exam or visit an optometrist. More studies of this nature should be conducted in Zimbabwe with larger sample sizes to increase the body of knowledge, raise awareness of the optometrist profession, and help in the policy-making concerning vision requirements for drivers. This information is important to all eye healthcare professionals and every driver.

REFERENCES

Adewole, A. O., Egwuenu, A. O., Ajisegiri, S. W., Adeomi, A. A., Adeoye, O. A., & Katbi, M. (2021). Requirements for Driving and Perceived Barriers to Accessing Eye Care Services; a Comparative Study of Government and Commercial Drivers in Southwestern Nigeria. *Journal of Interventional Epidemiology and Public Health*, *4*(14), Article 14. https://www.afenet-journal.net/content/article/4/14/full/

Alzahrani, H. S., Khuu, S. K., Ali, A., & Roy, M. (2019). *The effect of blue-blocking lenses on photostress recovery times for low and high contrast chromatic and achromatic stimuli* (p. 745000). bioRxiv. https://doi.org/10.1101/745000

Alzahrani, H. S., Khuu, S. K., Ali, A., & Roy, M. (2020). The Effect of Blue-blocking Lenses on Photostress Recovery Times. *Optometry and Vision Science*, *97*(11), 995–1004. https://doi.org/10.1097/OPX.0000000000001601

Babizhayev, M. A. (2003). Glare disability and driving safety. *Ophthalmic Research*, *35*(1), 19–25. https://doi.org/10.1159/000068199

Bener, A., Burgut, H., Sidahmed, H., Albuz, R., Sanya, R., & Khan, W. (2009). Road Traffic Injuries and Risk Factors. *Californian Journal of Health Promotion*, *7*, 92–101. https://doi.org/10.32398/cjhp.v7i2.2017

Bishwash, B., Kumar, D. T., Kumar, S. S., & Das, S. S. (2020). Normative value of photostress recovery time among various age groups in southern India. *Medical Hypothesis, Discovery & Innovation in Optometry*, *1*(1), 11–17. https://doi.org/10.51329/mehdioptometry102

Boadi-Kusi, S. B., Kyei, S., Asare, F. A., Owusu-Ansah, A., Awuah, A., & Darko-Takyi, C. (2016). Visual function among commercial vehicle drivers in the central region of Ghana. *Journal of Optometry*, *9*(1), 54–63. https://doi.org/10.1016/j.optom.2015.06.004

C, O., Bt, S., J, W., Me, S., & G, M. (2001). Visual risk factors for crash involvement in older drivers with cataract. *Archives of Ophthalmology (Chicago, Ill. : 1960)*, *119*(6). https://doi.org/10.1001/archopht.119.6.881

Chande, P. K., Raman, R., John, P., & Srinivasan, S. (2020). Contrast-Sensitivity Function and Photo Stress–Recovery Time in Prediabetes. *Clinical Optometry*, *12*, 151–155. https://doi.org/10.2147/OPTO.S259397

Chidi-Egboka, N. C., Bolarinwa, O. A., & Awoyemi, A. O. (2016). Photostress recovery time among commercial drivers in Nigeria. *Tropical Journal of Health Sciences*, *23*(3), Article 3. https://doi.org/10.4314/tjhc.v23i3

Chilaris, G. A. (1962). Recovery time after macular illumination as a diagnostic and prognostic test. *American Journal of Ophthalmology*, *53*, 311–314. https://doi.org/10.1016/0002-9394(62)91181-9

Constitution of Zimbabwe. (2013, May 22). *Constitution of Zimbabwe Amendment (No. 20) Act, 2013 (rev. 2017)*. https://www.constituteproject.org/constitution/Zimbabwe_2017?lang=en

Dzuke, A., & Naude, M. J. A. (2015). Procurement challenges in the Zimbabwean public sector: A preliminary study. *Journal of Transport and Supply Chain Management*, *9*(1), Article 1.

Glaser, J. S., Savino, P. J., Sumers, K. D., McDonald, S. A., & Knighton, R. W. (1977). The photostress recovery test in the clinical assessment of visual function. *American Journal of Ophthalmology*, *83*(2), 255–260. https://doi.org/10.1016/0002-9394(77)90624-9

Gopalakrishnan, S. (2012). *A Public Health Perspective of Road Traffic Accidents—PMC*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3893966/

Granié, M.-A., & Papafava, E. (2011). Gender stereotypes associated with vehicle driving among French preadolescents and adolescents. *Transportation Research Part F: Traffic Psychology and Behaviour*, *14*(5), 341–353. https://doi.org/10.1016/j.trf.2011.04.002

Hammond, B. R., Jr, Fletcher, L. M., & Elliott, J. G. (2013). Glare Disability, Photostress Recovery, and Chromatic Contrast: Relation to Macular Pigment and Serum Lutein and Zeaxanthin. *Investigative Ophthalmology & Visual Science*, *54*(1), 476–481. https://doi.org/10.1167/iovs.12-10411

Hollins, M., & Alpern, M. (1973). Dark adaptation and visual pigment regeneration in human cones. *The Journal of General Physiology*, *62*(4), 430–447. https://doi.org/10.1085/jgp.62.4.430

Horiguchi, M., Ito, Y., & Miyake, Y. (1998). Extrafoveal photostress recovery test in glaucoma and idiopathic central serous chorioretinopathy. *British Journal of Ophthalmology*, *82*(9), 1007–1012. https://doi.org/10.1136/bjo.82.9.1007

J, T., Jw, A., & M, P. (2002). Relation between glare and driving performance. *Human Factors*, *44*(1). https://doi.org/10.1518/0018720024494775

Kumar, M., Mahaseth, A., Parveen, S., Rafeeq, U., & Chauhan, L. (2022). Refractive errors among commercial drivers. *Indian Journal of Ophthalmology*, *70*(6), 2112–2116. https://doi.org/10.4103/ijo.IJO_2510_21

Loughman, J., Ratzlaff, M., Foerg, B., & Connell, P. (2014). SUITABILITY AND REPEATABILITY OF A PHOTOSTRESS RECOVERY TEST DEVICE, THE MACULAR DEGENERATION DETECTOR (MDD-2), FOR DIABETES AND DIABETIC RETINOPATHY ASSESSMENT. *RETINA*, *34*(5), 1006–1013. https://doi.org/10.1097/IAE.0000000000000021

Mangwaya, M. (2022, April 2). *Zinara launches crackdown on fake vehicle licence discs - Newsday Zimbabwe*. https://www.newsday.co.zw/2022/04/zinara-launches-crackdown-on-fake-vehicle-licence-discs

Mäntyjärvi, M., Juntunen, V., & Tuppurainen, K. (1999). Visual functions of drivers involved in traffic accidents. *Accident Analysis & Prevention*, *31*(1–2), 121–124. https://doi.org/10.1016/S0001-4575(98)00053-0

Margrain, T. H., & Thomson, D. (2002). Sources of variability in the clinical photostress test. *Ophthalmic and Physiological Optics*, *22*(1), 61–67. https://doi.org/10.1046/j.1475-1313.2002.00005.x

Muvuringi, M. P. (n.d.). *ROAD TRAFFIC ACCIDENTS IN ZIMBABWE, INFLUENCING FACTORS IMPACT AND STRATEGIES.* 76.

Mvogo, S. R. E., Dohvoma, V. A., Fangwa, J. S. N., Tsimi, C. M., Zoua, M. E. A., Nguena, M. B., Emilienne, E., Augustin, E., & Côme, E. M. (2019). [Age of onset of presbyopia in the black cameroonian subject]. *The Pan African Medical Journal*, *32*, 162. https://doi.org/10.11604/pamj.2019.32.162.15808

Natsikos, V. E., & Dean Hart, J. C. (1980). Photostress Recovery Times in Cases of Central Serous Retinopathy. *Journal of the Royal Society of Medicine*, *73*(11), 793–797. https://doi.org/10.1177/014107688007301108

Omokhua, P., & George, O. (2010). Photostress Recovery Time Among Nigerians. *Journal of the Nigerian Optometric Association*, *16*(1), 16–20. https://doi.org/10.4314/jnoa.v16i1.56627

Peden, M. (2004). World Health Organization dedicates World Health Day to road safety. *Injury Prevention*, *10*(2), 67–67. https://doi.org/10.1136/ip.2004.005405

Piyasena, P., Olvera-Herrera, V. O., Chan, V. F., Clarke, M., Wright, D. M., MacKenzie, G., Virgili, G., & Congdon, N. (2021). Vision impairment and traffic safety outcomes in low-income and middle-income countries: A systematic review and meta-analysis. *The Lancet Global Health*, *9*(10), e1411–e1422. https://doi.org/10.1016/S2214-109X(21)00303-X

Plainis, S., Murray, I. J., & Pallikaris, I. G. (2006). Road traffic casualties: Understanding the night-time death toll. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention*, *12*(2), 125–128. https://doi.org/10.1136/ip.2005.011056

Salvi, S. M., Akhtar, S., & Currie, Z. (2006). Ageing changes in the eye. *Postgraduate Medical Journal*, *82*(971), 581–587. https://doi.org/10.1136/pgmj.2005.040857

Setia, M. S. (2016). Methodology Series Module 3: Cross-sectional Studies. *Indian Journal of Dermatology*, *61*(3), 261. https://doi.org/10.4103/0019-5154.182410

Severin, S. L., Tour, R. L., & Francisco, S. (1966). *Macular Function and the Photostress Test 1*. 6.

Sherman, M. D., & Henkind, P. (1988). Photostress recovery in chronic open angle glaucoma. *British Journal of Ophthalmology*, *72*(9), 641–645. https://doi.org/10.1136/bjo.72.9.641

Skaar, N., Rizzo, M., & Stierman, L. (2010). Glare disability with attention impairment. *Journal of Vision - J VISION*, *3*, 719–719. https://doi.org/10.1167/3.9.719

Steinkuller, P. G. (2010). Legal Vision Requirements for Drivers in the United States. *AMA Journal of Ethics,* 938–940. https://doi.org/10.1001/virtualmentor.2010.12.12.hlaw1-1012

Stringham, J. M., O'Brien, K. J., & Stringham, N. T. (2016). Macular carotenoid supplementation improves disability glare performance and dynamics of photostress recovery. *Eye and Vision*, *3*(1), 30. https://doi.org/10.1186/s40662-016-0060-8

Tagoh, S., Kyei, S., Kwarteng, M., & Aboagye, E. (2020). Prevalence of refractive error and visual impairment among rural dwellers in mashonaland Central Province, Zimbabwe. *Journal of Current Ophthalmology*, *32*(4), 402. https://doi.org/10.4103/JOCO.JOCO_224_20

Tsiko, S. (2018). *UZ study shows most Harare kombi drivers are 'blind.'* 6.

WHO. (2022, January 22). *WHO: Zim has highest road crash deaths in Southern Africa; bad roads blamed—NewZimbabwe.com*. https://www.newzimbabwe.com/who-zimbabwe-has-highest-road-crash-deaths-in-southern-africa-bad-roads-blamed/

Appendix I: Study questionnaire

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Title: Photo stress recovery time and incidence of RTAs among commercial drivers in Bindura.

PART 1

DEMOGRAPHIC DATA_	**DATE**	
1. PARTICIPANT CODE		
2. AGE		
3. GENDER	0= Male 1= Female	
4. EDUCATIONAL **5. BACKGROUND**	0= Primary 1= Secondary 2= Vocational 3= Tertiary 4= None	

PART 2

Please have you experienced the following symptoms whiles driving or after driving (may have more than one symptom). The symptoms have been graded in terms of severity (0, 1, 2, 3). Tick (√) 0 for none, 1 for mild, 2 for moderate, and 3 for severe.

OCULAR SYMPTOMS	SEVERITY

	N ONE 0	MILD 1	MODERATE 2	SEVERE 3
6. Itchy eyes				
7. Red eyes				
8. Foreign body sensation				
9. Watery eyes				
10. Glare				
11. Difficulty seeing at far				
12. Difficulty with near vision				
13. Photophobia				
14. headaches				

PART 3

OCCUPATIONAL DATA	ANSWERS OPTIONS	ANSWER
15. How long you have been driving?	0= 1 - 5 years 4= 20 years and above 1= 5- 10 years 2= 10-15 years 3= 15-20 years	
16. Do you have a license	0 = No 1 = Yes	

17. What type (class) do you have?	0= NONE 2= CLASS 1 4= CLASS 4 1= CLASS2 3= CLASS 3 5=CLASS 5	
18. Did you have your eyes tested upon issuance?	0 = No 1 = Yes	
19. When did you last renew your driver's license	0 = 1 year ago 1= 2 years ago 3= more than 2 years ago	
20. Did you have your eyes tested upon renewal?	0= No 1=Yes	
21. Were you referred for an eye test?	0 = No 1 = Yes	
22. If yes, did you go?	0 = No 1 = Yes	
23. Have you worn glasses before?	0= No 1= Yes	
24. Do you still wear them?	0 = No 1 = Yes	
25. Why do you wear them?	0 = for sight/vision 3= to block excess light 1= reading/near work from sun or oncoming 2= fashion 4= others	

CLINICAL EXAMINATION

		OD	OS
26. VISUAL ACUITY	DISTANCE		
	NEAR		
27. PUPILLARY DISTANCE	DISTANCE		
	NEAR		
28. Photo stress recovery time			

29. Ocular structures

OD	STRUCTURE	OS
	Eyelid and eyelashes	
	Cornea	
	Conjunctiva	
	Pupil	
	Crystalline lens	
	Vitreous	
	fundus	

Appendix II: Informed consent form

BINDURA UNIVERSITY OF SCIENCE EDUCATION

INFORMED CONSENT FORM

Research title: Photo stress test recovery time and incidence of RTAs among commercial drivers in Bindura.

Researcher: Munashe Marufu

Project description

This study seeks to determine the impact of photo stress recovery time on road traffic accidents among commercial drivers in Bindura. Photo stress recovery time is a technique used to test the functional ability of the macular. The macular is a very sensitive part of the retina, it provides a well-defined image, central vision, and colour vision. Road transport is the most common mode of transport and has also the highest number of accidents, so to minimize these accidents the driver must have perfect vision.

Objectives

- To measure the normative photo stress recovery time among commercial drivers in Bindura-Zimbabwe.
- To determine any correlation between photo stress recovery time and the likelihood of RTAs occurrence among commercial drivers in Bindura.
- To determine any correlation between drivers' age and photo stress recovery time.

Purpose of the study

This study seeks to determine the relationship between photo stress test recovery time, and its impact on RTAs and to assess the vision of drivers which could be used in policy amendments' in transportation. It assesses if photo stress is also a cause of road traffic accidents and adds to the body of knowledge and saves as a guide to other researchers.

Rights of participants

Participation of the drivers will be voluntary and they will be allowed to withdraw at any stage if they wish to without any prejudice from investigators. Information about the participants will be anonymized to ensure privacy and confidentiality under a password-protected computer which will be only accessible to the investigator.

Reimbursements: The commercial drivers will not be provided with any form of payment for taking part in the study.

Potential benefits of the study

Results will show the importance of measuring photo stress recovery time for drivers and potentially inform new or additional tests that could be required for obtaining a driver's license to reduce the occurrence of this.

Authorization

Participant’s

signature………………………………….Date…………………………

Researcher’s

signature ………………………………….Date………………………….

Appendix III: Ethical Clearance

RESEARCH ETHICS COMMITTEE

P. Bag 1020
BINDURA, Zimbabwe
Tel: 263 - 7621-4
Email : rec@buse.ac.zw

BINDURA UNIVERSITY OF SCIENCE EDUCATION

25 July 2022

Dear- Marufu Munashe - B191326A

RE: RESEARCH ETHICAL CLEARANCE - Photo stress recovery time and incidence of RTAs among commercial drivers in Bindura.

Thank you for the application for review of Research Activity that you submitted to Bindura University of Science Education Research Ethics Committee (BUSEREC). Please be advised that your protocol has been reviewed and was approved.

This approval is based on the review and approval of the following documents that were submitted to BUSEREC for review:

1. Study protocol

Approval Number: **0027/2022** should be used on all correspondence, consent forms and documents as appropriate.

Type of Meeting	:	Expedited
Approval Date	:	26/07/2022
Expiry date	:	25/07/2023

After the expiry date, the project may only continue after renewal. For purposes of renewal, a progress report should be submitted three months before the expiry date for continuing review.

All serious problems to do with safety of participants must be reported within three (3) working days to BUSEREC. You are not expected to make any changes/adjustments to the protocol including the consent documents. Any trials involving drugs, devices and biologics require approval of the Medicines Control Authority of Zimbabwe before commencement.

Upon termination of the study, a report has to be submitted to BUSEREC.

Yours sincerely

………………….…………………..
S. Muyambo.
BUSEREC CHAIRPERSON

Appendix IV: Approval Letter

Telephone: 263 4 700991/9
Fax: 263 4 723568 or 704303 or 737358
Telegraphic Address: "TRANSPORT"

ZIMBABWE

Ministry of Transport and Infrastructural Development
P.O. Box CY 595
Causeway
HARARE

01 August 2022

Ms Munashe Marufu

Head Office

RE: AUTHORITY TO CONDUCT AN ACADEMIC RESEARCH IN THE MINISTRY OF TRANSPORT AND INFRASTRUCTURAL DEVELOPMENT: MUNASHE MARUFU

The above subject matter refers.

Please be advised that the Secretary for Transport and Infrastructural Development has approved your request to carry out a research in this Ministry. Your approved research topic is, ***"Photo-stress recovery time and its incidence on road traffic accidents among commercial drivers in Bindura".***

The information and assistance you shall be given should be purely used for academic purposes only and a copy of the final dissertation shall be availed to this Ministry.

Please be guided accordingly.

MINISTRY OF TRANSPORT AND INFRASTRUCTURAL DEVELOPMENT
DIRECTOR (HUMAN RESOURCES)
- 1 AUG 2022
P.O. BOX CY 595, CAUSEWAY
ZIMBABWE

B.A Murungweni
For: Secretary for Transport and Infrastructural Development