Optometry Unit Department of Clinical Surgical Sciences, Faculty of Medical Sciences, St Augustine, The University of the West Indies.

TITLE - The Visual Status of Drivers in Trinidad.

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DECLARATION

This research proposal is the original work of the researchers and has not been presented to any other institution. No part of this research should be reproduced without the authors' consent or that of The University of the West Indies.

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This research proposal has been submitted with our approval of The University of the West Indies, St Augustine Campus, Trinidad.

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ABSTRACT

Background: The grounds for conducting a research project of such a nature is due to the fact there has been an increase in road traffic accidents (hereinafter referred to as "RTA") on the roadways in Trinidad, the majority of which have causes that are inconclusive as well as there not being any well-defined laws and regulations governing vision prior obtaining a driver's license.

Aim and Methodology: The study design for this research was done in a purposive manner where the target population consisted of drivers in Trinidad. In order to assess the visual status; seven different tests/examinations were conducted in the following order: 1) Visual Acuity, 2) Stereopsis, 3) Contrast Sensitivity 4) Colour Vision, 5) Disability glare test 6) Anterior and Posterior ocular health examination and 7) Intraocular Pressure. All tests were conducted with the candidates' consent. They were also required to complete a short questionnaire.

This article therefore summarizes; the current visual status of one hundred and twenty eight (128) drivers, demonstrates the main causes of visual impairment of drivers with correlating the effects of functional vision on the occurrence on RTA. It further assesses the knowledge and attitude among drivers towards eye care in Trinidad.

Findings and Conclusion: This research found that 32.0% (41) of the drivers were involved in a RTA in the last five years. This study concluded that refractive error (84.4%) was the most common form of visual function impairment followed by abnormal stereoscopic acuity (28.1%). In conclusion, this research established that there is an association between the occurrence of RTAs in the last five years and drivers having a log contrast sensitivity score greater than 1.52 as well as having abnormal colour vision.

ABBREVIATIOINS

I. **Log CS**: Logarithm of Contrast Sensitivity score.

II. **LogMar**: Logarithm of the Minimum Angle of Resolution.

III. **RTA**: Road Traffic Accident.

IV. **VA**: Visual Acuity.

DEFINITION OF TERMS

V. **Colour Vision Deficient**: Any driver that was unable to correctly identify more than 13 Ishihara Plates.

VI. **Contrast sensitivity**: The visual ability to correctly identify an object from its background; with varying degrees of luminance.

VII. **Driver**: A participant of this study.

VIII. **Driver's license**: A permit issued to a driver pursuant to section 44 of the Motor Vehicles and Road Traffic Act Chapter 48:50.

IX. **Glare**: A reduction in vision due to intensities of light greater than that to which one's eye is adapted to.

X. **Ishihara Plates**: The pseudo-isochromatic used to assess and test for colour vision deficiencies, more specifically red-green deficiency

XI. **Prevalence**: proportion of a population that experiences a specific characteristic in a given time period.

XII. **Road traffic accident**: In terms of this report, this means an incident that was faced by a driver which either resulted in a fatality, injury or ultimately damages to a life or property.

XIII. **Visual Acuity**: A vision score which was done to measure the ability of the driver to recognize letters on a stationary positioned LogMar chart at a distance of 3m.

XIV. **Visual Function**: In terms of this report, the term Visual Function is the how well eyes operate in a visual system, ie. how well the function of the eyes in a system.

XV. **Visual Impairment**: This term used to refer to any driver who experienced any kind of visual loss which was examined in this research

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CHAPTER ONE: THE INTRODUCTION OF STUDY

1.0 Introduction

The relationship between vision and driving is quite a complex scenario as there is no clear definition for what perfect vision is as well as what is a perfect driver. Although there might be procedures to declare someone as having the perfect visual function there is no clear method to assess what constitutes a perfect driver.

The ability to see is indisputably a fundamental component of being considered a good driver, due to the fact that the action of driving relies heavily on vision for its successful and proper execution [1]. Research over the past few decades has explored the role of vision in safe driving namely with respect to RTA and driving performance [1] .Vision attributes to about 95% of the sensory requirements for driving [2] . Clear and comfortable vision is important for driving for a number of reasons which include; to assess distance, in reading of road signs and traffic lights as well as in responding to changes in the traffic environment quickly and efficiently. Impaired visual function will inevitably translate into a delayed response or at all or failure to perceive potentially dangerous situations exposing the drivers themselves, passengers and other road users to easily avoidable dangers. Therefore, a driver's vision will largely determine how efficiently he will perform which would determine the likelihood of an RTA.

1.1 Background of study

The relationship between visual function and RTA have been equivocal; with studies having conclusions that there is no association present between the impairment of visual

function and the occurrence of RTA; whereas on the other hand, other studies reported a weak relationship exists between impaired visual function and RTA.

RTAs has transpired to be classified as a major global public health problem of this century and are now recognized as a neglected pandemic. The WHO indicated that RTA accounts for 2.1% of total deaths and 21.0% of total injury globally, and developing and underdeveloped countries, such as Trinidad accounts for 80% of these deaths [3]. Therefore the motivation behind this project was solely by the societal need to preserve public safety on the lives in transit on the Trinidadian roadways by studying the members who constitute to the current driving population; since according to the World Health ranking; Trinidad and Tobago is currently ranked at the 97th position with regards to RTA, which is in-fact the highest ranked Caribbean country. Local statistical data has indicated that there has been a 22% increase in deaths and a 13% increase in fatal road traffic accidents for the year of 2019 in Trinidad [4].

According to Chapter 7 of the Sláinte agus Tiomáint which was compiled by the Road Safety Authority and the National Office for Traffic Medicine of Ireland, it is mandatory that prospective drivers who are currently seeking to obtain a driver's license or already in possession of one must fit a specific criterion for Visual Acuity and Visual Fields. Group 1 license applicants or holders must have a binocular Acuity, with a refractive correction if necessary, of at least 20/40 on a Snellen chart [5]. In Ireland, the visual assessment must be done by either a General Practitioner, Ophthalmologist or Optometrist. Additionally, in order for an individual to obtain a driver's license in Europe a driver must satisfy the conditions set by of the European Union driver's license requirements; which consists of visual acuity scoring, visual fields and in some European countries additional tests relating to driving on the roadway; such as the number plate eye test; particularly done in the United Kingdom. Whereas,

in the United States of America, the same regulations made by the European Union is followed, however having different visual acuity and field thresholds [8]. However, the regulations governing for the issue/renewal of a driver's license in Trinidad; does not have a specific Snellen/Logmar visual requirement nor a visual field angle of requirement; it is only an Ophthalmologist who can subjectively suggest if the candidate has adequate Snellen vision acuity to perform the task of driving.

1.2 Statement of Problem

Driving is the primary means of personal travel in many countries and is relies heavily on vision for its successful execution. Trinidad and Tobago is currently ranked as the highest country in Caribbean with regards to RTA occurrence; with being ranked number 97th on the global scale [7]. At present, the Motor Vehicle act, 48:50 which governs an individual to obtain a driver's license in Trinidad and Tobago; only requires a drivers' Snellen visual acuity score prior to obtaining a driver's license, which is subjectively evaluated by an Ophthalmologist as well as prospective drivers and those who are renewing their drivers licence also subjectively make note for themselves if they are required to drive with prescriptive lenses to view the distance correctly [6]. This vague legislation which governs the roadways in Trinidad and Tobago could be contributing to three hundred and fifty-eight severe road traffic accidents where approximately half of those involved in road traffic accidents died: all within a nineteen month period [7].

It is clear that optimal vision is one essential aspect in any person's life with regards to their mobile capabilities, in particular driving any type of motor vehicle. This research aims to investigate the visual status of drivers in Trinidad. The basis for conducting this research is that there is an obvious need to improve the safety along roadways in Trinidad.

1.3 Aim of study

The aim of the research is to assess the visual status among drivers and how it relates to road traffic accidents in Trinidad.

1.3.1 General Objective: To assess the visual status among drivers in Trinidad.

1.3.2 Specific Objectives:

1. To explore the visual function among drivers in Trinidad.
2. To determine the cause of visual impairment among drivers.
3. To determine the effect of visual function on the occurrence of road traffic accident.
4. To assess the knowledge among drivers towards eye care.

1.4 Research Questions

1. What is the visual status among drivers in Trinidad?
2. What is the major cause of visual impairment among drivers in Trinidad?
3. Can visual function contribute to occurrence of road traffic accidents?
4. What is the level of understanding of drivers in Trinidad regarding regular eye examination?

1.5 Significance of Study

The findings in this study will not just benefit Trinidad and Tobago, but it intends to benefit the wider world where there haven't been any studies into the visual status of vehicle drivers. It

intends to be the driving force to get Trinidad and Tobago on-board with the United Nations-Decade of Action [9] for Road safety 2011-2020.

The main beneficiary will be the government organization (The Ministry of Works and Transport) or related organizations that will help guide policies and legislation. They will help to determine if new laws need to be implemented for one to obtain a driver's license.

The Secondary and Tertiary beneficiaries of this study are: Administrators, Staff and Professors. The Administrators and Staff would benefit because they will be given a chance to organize an enrolment procedure for drivers found with visual impairments; and professors would benefit as it will aid with discussions regarding related lessons making it easier for them to tackle related topics about this topic with statistics being generated within and for Trinidad.

It is important to the researchers as it can also benefit them in the form of employment. The study could create employment for Optometrists within the industry, as legislations such as being signed off by an Optometrist before obtaining a driver's licence can be implemented.

Being the first of its kind in Trinidad and in the Caribbean, the findings of this project also benefits future researchers as it will serve as a guide and reference for students undertaking similar studies in the future.

CHAPTER TWO: THE LITERATURE REVIEW OF STUDY

2.0 Literature Review

The World Health Organization estimates that there are roughly 1.3 billion persons with visual impairment. The organization also concluded that 217 million of them experience moderate to severe visual damage and 36 million are blind; additional conclusions were that at a global level, an estimated 80% of all visual impairment are preventable [9].

The International Classification of Diseases 11 (2018) classifies vision impairment into two groups, distance and near presenting vision impairment, as drivers mostly dependant on their distance vision, this will be the one primarily investigated. According to the WHO there are four categories of Distance vision impairment [9]:

- Mild vision impairment – presenting visual acuity worse than 6/12
- Moderate vision impairment – presenting visual acuity worse than 6/18
- Severe vision impairment – presenting visual acuity worse than 6/60
- Blindness impairment – presenting visual acuity worse than 3/60

2.1 The Visual Knowledge

A study conducted in the South West region of Nigeria aimed to determine the ocular status of commercial intercity drivers. This descriptive cross-sectional study was conducted in a four-month period, where clearance from the necessary boards was approved prior to the commencement of the study [10]. Apart from measuring the visual acuity with a Snellen's chart, the general health of each participant's eye was examined using an ophthalmoscope and a penlight. A

semi structured questionnaire was also administered which enabled the researchers to obtain the necessary demographical bio-data which aid in their data analysis, which was done by the Statistical Package for Social Sciences (SPSS) statistical software. Additionally, the researchers conducted a cross tabulation of the visual acuity results obtained with the involvement with road traffic accidents using a chi-square test. This study concluded that the prevalence of visual impairment in the better eye was very low. It also revealed that most of the drivers did not have an ocular assessment and it should be a requirement to obtain a driver's license in Nigeria. This study did not; state a value for an ideal visual acuity measurement or did it examine the visual field and check for colour vision deficiencies as well as it did not assess the drivers' knowledge of an eye exam. However, in a more recent yet similar study conducted in North Central Nigeria focused on the Visual Function among Commercial Drivers. This study followed a similar method to the research done in South Western region, but no analysis was done to compare the results obtained to the involvement of road traffic accidents [11] .However, based on the objective answers given in the questionnaire revealed that there was a significant association exists between visual acuity and the probability of road traffic accidents. Additionally, it was discovered that there is no significant association between a visual field defect or abnormal colour vision with road traffic accidents. But this study not only utilized the Ishihara Pseudoisochromatic Plates, which is only identifies a Protanope, but this research also used the confrontation test as the method for visual field analysis. Hence, a Farnsworth Munsell test as well as an automated perimetry test should be used to adequately correlate and compare colour vision and visual fields to the road traffic accident data.

Furthermore, a study done in Odisha India addressed the prevalence of visual status impairment [12]. This study possessed some degree of similarity to the studies conducted Omolase et al [10] ; it was also a descriptive cross-sectional study conducted within a three-month period as

well as a cross tabulation of the visual acuity measurement and the road traffic accident occurrence rate. However, the tests conducted for this research only consisted of visual acuity measurements and colour vision assessment using the Ishihara Pseudoisochromatic Plates. In this study Kshatri et al discovered that; 29.2% of the drivers suffered from ocular morbidity with refractive error was the most common; and 39.6% of the commercial drivers had an immature cataract. In this study, it also showed that 94% of the drivers had visual acuity readings within the range of 6/5 to 6/18, where the remaining, 6% had measurements within the 6/18 to 6/60 range. This study was comprised of one hundred and ninety-five (195) commercial drivers which meant that approximately 15 drivers within one community in the state of Odisha India had visual acuity readings to qualify them as legally blind; according to the Medical Advisory Board. This study did not include any degree of visual field analysis. This study concluded that there is not any significant relationship between road traffic accidents and visual impairment, however it is stated that a Farnsworth Munsell 100 Hue test be used. In a similar study conducted in Hong Kong assessed the vision status of commercial vehicle drivers [13]. The researchers collected the current accident casualty rate as well as the vision-related requirements to obtain a driver's licence from 15 different transport divisions worldwide. The tests carried out by the research team consisted of visual acuities, colour vision and stereopsis; with addition to a questionnaire which provided the researchers with the necessary bio-data to further analyse and interpret the findings from the tests carried out. From the questionnaire, the researchers discovered that majority of drivers had complaints of ocular fatigue and sensitivity to glare. From the tests conducted 5% of the 420 drivers had distance visual acuities worse than 6/18, 18.5% of the drivers had poor stereoacuity and approximately 9.9% of the commercial vehicle drivers had poor colour vision. The researchers did not indicate a value for what is defined as poor stereoacuity, or did their indicate which

stereoacuity chart their used to evaluate the participants; but, the researchers concluded that since there is no standardized vision criteria adopted from licensing authorities worldwide, laws must be implemented[12].

2.2 Prevalence of Visual Function Impairment

Meanwhile a research conducted by the Andhara Pradesh Eye Disease Study (APEDS) revealed the prevalence of visual impairment in a southern Indian state [14]. It should be noted that this study not only targeted drivers, individuals aged 30 and above from urban and rural areas who were selected using a multistage random technique; this served as variable in terms of socioeconomic status. The procedures carried out by the APEDS were that of a general routine eye examination but a LogMar chart was utilized instead of a Snellen's chart, but a colour vision assessment was not done. In spite of that, the APEDS revealed that the prevalence of moderate visual impairment adjusted for age, sex, and urban-rural distribution was 8.1% (95% confidence interval). The researchers defined moderate visual impairment as having an acuity value of 6/18 to 6/60 in the better eye. The distribution of visual impairment was refractive error (45.8%) where cataracts were second in line (39.9%). For the purpose of analysis and discussion, the prevalence of cataract and refractive errors were combined since these two accounted for majority of the impairments. In that regard, the prevalence was 2.90% (95% confidence interval) for the urban area and 4.0% (95% confidence interval) in the rural areas. This study further evaluated the distribution and, it was determined that: there were higher odds of a female in the rural areas having visual impairments. This study provides a wealth of information to the current study being conducted entitled "Visual status of drivers in Trinidad" since statistics revealed that East Indians makes up the majority of the population in Trinidad and Tobago. [15]

2.3 Effects of Visual Function Impairment

In furtherance, a study conducted by the Institute of Neurological Science, Cosenza Italy aimed to investigate colour vision in everyday life and car driving [16]. This study implemented the use of the Ishihara test, where a purposive sampling method was used to achieve the researchers' goal. Initially, the researchers screened individuals of age thirteen to sixteen; where there were grouped into two categories; those with a colour vision defect and those with normal colour vision. After three years, where the subjects were at the legal age to drive in Italy; the researchers contacted each subject who was identified with a defect was contacted via the telephone and asked to undergo a psychosocial questionnaire also through the telephone. In order to analyse their data, the researchers used a Fisher test, Chi-square test and a Mann-Witney U- test for the quantitative analysis. From the 453 subjects that took the survey, 18.3% of these young drivers were involved in a road traffic accident, 98.4% had delays in identifying the traffic light signals and 12.4% were suffering from myopia. This study possesses some similarity to the one being currently done, since it is a purposive study done with non-probability sampling. However, this study only used the Ishihara plates, which can only identify an acquired colour vision defect, and has several disadvantages by administering a questionnaire over the telephone; the major one being that it is very difficult to establish if the subject in telling the truth. Additionally, it has been stated quite a number of the more severe red-green colour vision deficient drivers are aware that they have problems at road traffic lights [17]. It further went on to say that during a survey, 49% of dichromats and 18% of anomalous trichromats had difficulties perceiving the colours of traffic lights. There were also reports of red lights being occasionally missed by 16% of protanopes and 12% of protanomals and 20% of dichromats encountered problems seeing brake lights. Therefore, the possibility of an increased risk of those who are unaware of having a colour vision problem exists.

CHAPTER THREE: THE METHODOLOGY OF STUDY

3.1 Research Design

This descriptive cross-sectional study utilized a non-probability purposive sampling approach to enrol drivers in Trinidad. The data was obtained from two sources: an ocular examination as well as a semi- structured questionnaire. The questionnaire was firstly tested and re-tested in a pilot study containing ten (10) drivers who did not take part in the actual research study. The questionnaire contained sections on socio-demographics, duration of driving, perceived difficulties in driving related to visual status as well as brief history on their driving experience. However, the ocular examination provided the researchers with the measurements of the driver's current visual status. The tests to examine the ocular status included seven non-invasive procedures such as; visual acuity, external and internal eye examinations, tonometry, colour vision, motility testing, stereopsis, contrast sensitivity and disability glare testing.

The results and responses of the ocular examination and questionnaire was then cross tabulated and analysed accordingly.

3.2 Study Population

This study comprised of subjects who came from various ethnic backgrounds, religious and political beliefs and were within the age range of twenty (20) to seventy (70), subjects must have had at least one year driving experience as well as having a valid driver's license obtained from the licensing authority of Trinidad and Tobago. Unfortunately, candidates who are less than twenty-one years of age, those who are institutionalized or not mentally or physically able to

communicate, as well as those who do not consent to participate in the study were excluded in this study.

3.2.1 Area of Study

This research was conducted at the UWI Optometry Clinic located in Couva, in compound of the Law Association of Trinidad and Tobago, Port-of-Spain as well as in Griffin Court Port-of-Spain. These locations were chosen due to two factors;

1) Ease of Convenience to the researchers.

2) To obtain results from the Port-of-Spain and Environs.

Having population of approximately of 48,858 and an area of 723km^2, Couva is considered and labelled as an urban town in Trinidad's Western Central Region. [18]. However, in the political map, Couva is classified as being part of the Couva-Tabaquite-Talparo district which is the third largest district in Trinidad and Tobago. The 'Couva district' is approximately 15km from the City of San-Fernando, 10 km to Borough of Chaguanas and 30km away from the City of Port-of-Spain. With the UWI Optometry clinic being located at Couva meant that it was more easily and readily accessible for the population of the South and Central areas to attend the clinic, which inevitably meant that there was going to be a lack of participants from the East and Western regions of Trinidad. Having this present, screenings were done at the City of Port-of-Spain.

Port-of-Spain, being declared the capital of Trinidad since 1784 is the country second largest city. Having approximately a population of 118,216[19] is the mid-point in the large conurbation extended from the Chaguaramas in the West to Arima in the East, with an approximate

population of 600,000. Having an approximate transient daily population of 25,000[19] made this an ideal location to target participants from the East and West of Trinidad. The locations intra-Port-of-Spain were chosen due to convince to the researchers as they were familial links to the organizations.

3.2.2 Inclusion Criteria

The participants were citizens of Trinidad, had least one-year driving experience as a driver, and were above the age of twenty-one and less than seventy.

3.2.3 Exclusion Criteria

Candidates who were less than 21 years, previously institutionalized or not mentally or physically able to communicate, as well as those who do not consent to participate in the study were excluded from the study.

3.3 Sample Size and Sampling Technique

Using a Purposive sampling technique, this study consisted of 128 drivers, who were within the inclusion criteria.

3.3.1 Sample size determination

Using Raosoft-sample size calculator the potential sample size was generated. Using a 95% confidence interval and a margin of 5% error; the software generated a population size of three hundred and seventy-seven (377) drivers. This generated population size was originally 'divided' into the eight, since this project targeted the eight counties in Trinidad, hence giving the researchers a value of approximately forty-seven drivers in each county. Unfortunately, due to global COVID-19 Pandemic in 2020, this generated sample size of three hundred and seventy-seven (377), was not reached but one hundred and eight drivers (128). These drivers all fit in the inclusion criteria and all resided in either of the nine counties in Trinidad.

3.3.2 Sampling Technique

This descriptive cross-sectional study utilized a non-probability purposive sampling approach to enrol drivers within districts of Trinidad. The participant ultimately made the first contact by phone call, via email and by the use instant messaging to the investigators stating that whether he or she is interested in partaking in the project after reading through the flyer, notice containing the information about the research project, or the social media posts.

On making this call, the prospective participant had the opportunity to clarify information about the study with the researchers; and once the participant understood they were then informed of the consent process. They were enlisted in a code book and a follow up call was made to the candidate to find out their availability for the project.

The date and time of each candidate's procedures was done most convenient to the subject. Informed consent was then obtained from all the respondents, and the research was conducted strictly following the Helsinki's Declaration.

3.4 Ethical Consideration

Approval of this study was firstly approved by Optometry Unit followed by the Chairman of the Ethics Committee, University of the West Indies. The participants were all within the legal age therefore being able to complete the required consent form by themselves and were allowed to ask the researchers if they had any concerns or clarifications on the consent form. On giving consent to participate in the study, the candidates were then allowed to complete a questionnaire which contained sections on socio-demographics, duration of driving, perceived difficulties in driving related to visual status as well as brief history on their driving experience.

The non-invasive procedures carried out were all routine clinical procedures; however in this scenario there are all experimental and were carried out in the order in which they are listed; Colour vision, stereopsis, contrast sensitivity, tonometry, visual acuity, disability glare, ophthalmoscopy. It was carried out in this manner since, it is very easy for a test that includes light can affect the vision, depending on the person`s visual recovery time.

The information and results obtained were given to the candidates verbally in a private room with only the researchers and the participants as this will go a long way to ensure confidentiality and privacy of the participate.

There were no risks involved therefore the likelihood of a risk occurring was low. Confidentially was heightened with the participants being coded with numbers 1 to 10 as well as

letter/s which provided anonymity for each participant. If the subject was found with any ocular abnormalities the subject was referred accordingly according to the presenting case.

3.5 Tests and Instrument/Equipment

In order to evaluate the visual status of drivers, the following tests were done as follows: colour vision, stereopsis, contrast sensitivity, tonometry, visual acuity, pinhole visual acuity, disability glare and ophthalmoscopy.

Colour Vision – performed with the Ishihara test for Colour Vision

The Ishihara test is a quick and fast test to check if there are any abnormalities present with an individual's colour vision. The abnormalities detected with this test, ultimately meant that the person was referred to the UWI Optometry Clinic to have a full colour vision workup done.

The test was conducted in a well-lit environment imitating the effect of natural daylight. The participant was informed that he/she would have approximately 5-10 seconds to identify what number is present on the plate, and the trace plates should be conducted in 10-15 seconds. Being held at approximately 75cm away from the participant with the plane of the plate being at right angle to the line of sight from the driver, the test was completed for all participants with no need to alter the variation of the order of the plates as all of the participating driver showed no lack of interest.

Stereopsis – performed with the TNO fly test

To assess the driver's depth perception the TNO fly test was utilised as it was will guide the researchers to know how well the drivers can identify 3-D objects in front of them, more so another vehicle. The test was conducted in a well-lit environment imitating the effect of natural daylight, with the participant wearing 3-D glasses as per regulation of this test. The booklet was held at approximately 40cm from the driver. The driver was asked to identify the 63'' circle that appeared to be popping out. Once this was identified accurately, the driver was asked to continue identifying the circle that appeared 3-D to them, until they could not of either; recognise which circle is 3-D or completed all. However, if the driver was not properly able to identify the circle that represents the 63'', they were carried up to the 400'' which in this case was the fly; itself.

Contrast Sensitivity- performed using the Mars Letter Contrast Sensitivity Test

This test was done in order to assess the drivers peak visual contrast sensitivity, using low retinal spatial frequencies. The test was conducted in a well-lit environment imitating the effect of natural daylight. The patient was firstly informed that the chart given to them may look a little faded, but that is how the was designed in order to test their ability to see in low contrast. The candidate held the chart without the plastic coating about 40 cm from themselves: with their personal required refractive correction. With the Right eye being firstly occluded the plate 1 was showed and the participant was asked to read left to right, with the driver being encouraged to guess if unsure. Plate 2 was then used with the left eye and plate 3 with both eyes being opened. On all three instances, the candidate was encouraged to guess if unsure.

Plate 1 – Row 1 – CHVOSN

Plate 2- Row 1- KSHONC

Plate 3 – Row 1 – HRZVCN

Tonometry- performed with the i-care 300

In order to evaluate the ocular health of the driver's eyes, IOPs were done as an elevated IOP along with optic disc changes could simply mean that the candidate is a latent glaucoma patient especially if the driver is asymptomatic. If an elevated IOP, in this instance above 22mmHg was recorded the candidate was referred to the UWI Optometry clinic to have a complete eye exam.

The test and purpose were explained to each candidate. Each probe was disinfected with rubbing alcohol and given ample time to dry before making contact to the cornea to record the eye pressure.

Distance Visual Acuity – done with a 3m LogMar chart

The driver's ability to see in the distance was measured with how well they were able to identify the letters on the LogMar chart. The test was conducted in a well-lit environment imitating the effect of natural daylight. With the right eye being occluded the drivers were asked to identify the 20/40 line ie. the 0.3 LogMar line. Once they were able to identify this line they were asked to move further down the chart until they could not identify the letter/s. If the candidate was unable

to identify the 0.3 LogMar line, they were asked to start from the top row. With the left eye being occluded and with both eyes being open the same steps were taken.

Pinhole Visual Acuity – Utilising Pinhole eye shield and 3m LogMar Chart

In order to assess if the driver had a refractive or pathological issue that was causing him/her to not be able to see the LogMar chart clearly, Pinhole visual acuity was done in order to determine if the driver had some underlying pathological issue or just a refractive error. This was done with a pinhole eye shield and the 3m LogMar chart, once an OU VA was done. Firstly the pinhole was place over the right eye, with the participant asked to read from the line they stopped at with the 3m LogMar chart, if the VA was improved it was noted and the pinhole was then placed in front the left eye.

Disability glare testing- Utilising the 3m LogMar chart and flashlight

With the candidates wearing their refractive error correction, and the environment imitating the effect of natural daylight, a flashlight was placed approximately 30cm subtending at an angle of 30^0 from the driver's line of sight while looking at the LogMar chart. If the visual acuity decreased of increased with the use of the disabling light, it was recorded. This gives the researchers how the effect of glare can affect the driver's vision while on the roadway.

Ophthalmoscopy- Using Keeler Specialist Ophthalmoscope

In order to evaluate the health of the eye, ophthalmoscopy was performed on both the anterior and posterior eye. Performing this task, the researchers were able to detect the presence of any underlying medical or ocular ailments such as diabetes or glaucoma. Once any irregular ocular finding was found with the participant; he or she was referred to the UWI Optometry Clinic.

With the test being explained to the candidate it was performed in a dark room, to ensure the eyes were dilated. On starting the test, the candidates were informed that the researcher will be close to his/her space and on occasion touch the eye lids or face of the candidate. Once the candidate understood that, standard and routine Ophthalmoscopy procedures were done.

3.6 Data Collection Procedure

The data was obtained from two sources: an ocular examination as well as a semi-structured questionnaire. Before commencing, the candidates were asked to give consent to partake in the research by giving written consent using the UWI ethics form.

The questionnaire contained sections on socio-demographics, duration of driving, perceived difficulties in driving related to visual status as well as brief history on their driving experience which was adapted from a previous and similar study done by Kusi et al[24].

However, the ocular examination provided the measurements and results of the driver's current visual status. The data collected from the questionnaire and the ocular examination were cross tabulated by imputing the data on the created data collection sheet.

3.7 Data Analysis

The data generated from this study was analysed using the Statistical Package for Social Sciences (SPSS) version 19 for Microsoft Windows 10 Home Edition version 1903. Initially the data was entered on Microsoft Excel 2015 Edition, where it was placed in categories as seen in the appendix. In order to further categorize the data, a binocular LogMar score higher than 0.2 was classified as abnormal, whilst a LogMar score of less than 0.2 binocularly was considered to be normal, as similar to the Drivers' and Vehicular License Act of 1999 (Act 569) of Ghana [20]. The Intraocular Pressure was categorized into 2 subgroups which were labelled as below 22mmHg, which was classified as normal and above 22mmHg which was noted as abnormal, as stated by Department of Ophthalmology, Icahn School of Medicine at Mount Sinai in New York, NY[21]. A log contrast sensitivity of 1.52 or higher was classified as normal and below 1.52 as abnormal, as stated by the manufactures of the Mars Letter Contrast Sensitivity Test [22]. In order to further categorize stereoscopic acuity, the standard of below 50'' was set to be considered as normal and scores higher than 50'' to be abnormal as stated by Lee et al, 2005[23]. These standards were created due to the fact there are no set standards and laws in Trinidad and Tobago which governs a person visual status in order to obtain a driver's license.

The categories of the data as well as their subcategories were all meticulously transferred and analysed with SPSS. With all data being considered as categorical data, cross tabulation was done on all data as well as contingency Chi square (χ^2) tests was done on the sub-categorical data, within the 95% confidence level and Cramer V score used to measure the strength of the association determined by the Chi square tests.

CHAPTER FOUR: RESULTS OF STUDY

4.0 Results

Demographic Data and Driving History

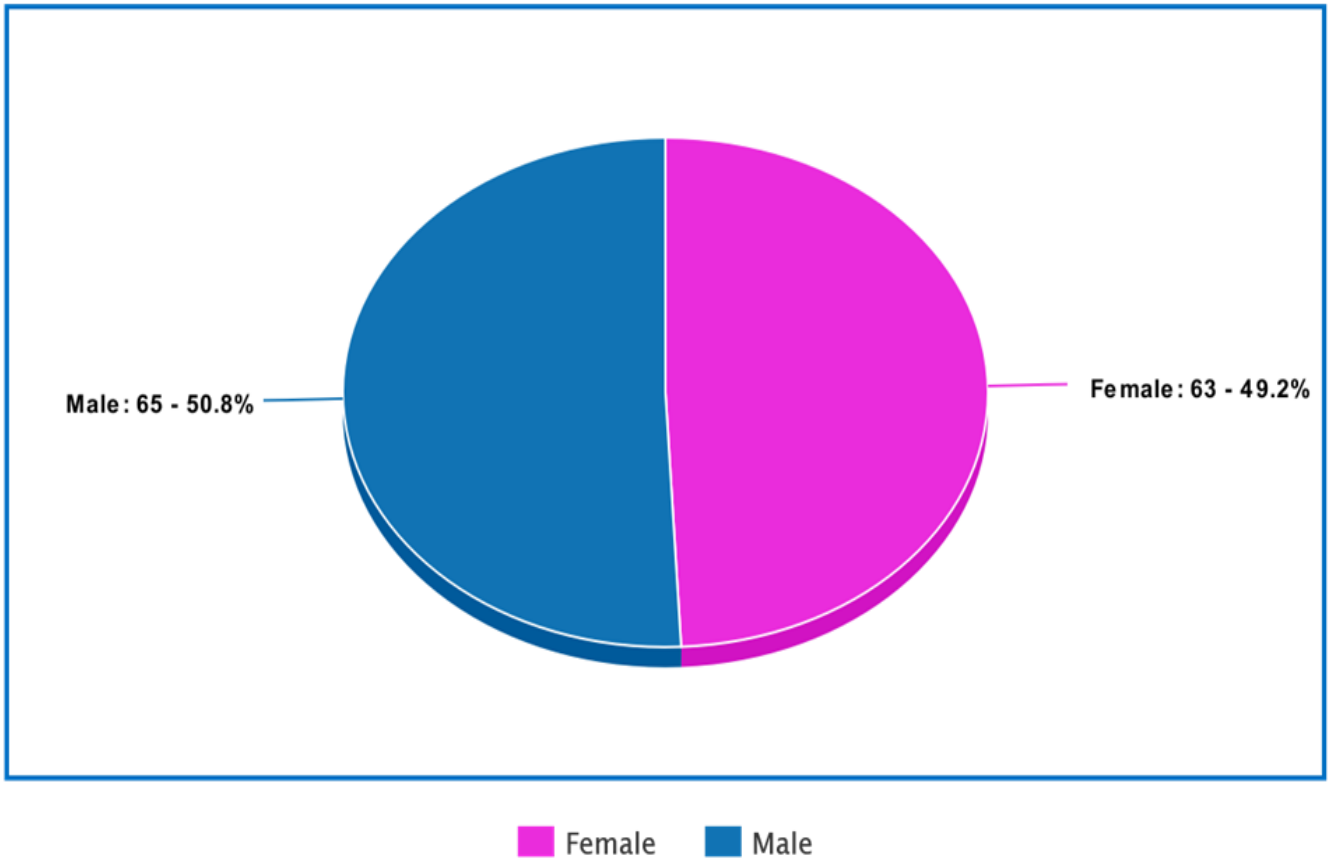

Figure 1.0: Pie- chart showing the gender distribution of drivers that participated in the study.

From the illustration above, it is observed that majority of the drivers examined in this study; were that of the male population (50.8%).

Age Group	Frequency	Percent
20-30	35	27.3
31-40	33	25.8
41-50	25	19.5
51-60	23	18.0
61-70	12	9.4
Total	128	100.0

Table 1.0: Age distribution of drivers that participated in the study.

Table 1.0 indicates that majority of the drivers examined for this study were within the age range of 20-30; with drivers within the age of 61-70 representing the minority of the study population.

Ethnic Background	Frequency	Percent
White/Caucasian	9	7.0
Hispanic/ Latino	17	13.3
Indo-Caribbean	49	38.3
Afro-Caribbean	53	41.4
Total	128	100.0

Table 1.1: Ethnic background of drivers that participated in the study.

From this table, it is clear that majority of the participating drivers subjectively classify themselves as Afro-Caribbean with the minority of the drivers classifying themselves as White/Caucasian.

Level of Education	Frequency	Percent
Primary School	7	5.5
CSEC Level	21	16.4
A levels/ CAPE	37	28.9
Tertiary Education	62	48.4
Other	1	0.8
Total	128	100.0

Table 1.2: Education levels of the drivers that participated in the study.

This table indicates that majority of the drivers are currently enrolled or graduated from a tertiary level institution, with one driver subjectively classifying him/herself as completing some other form of education.

Had an eye exam before obtaining/renewing license	Frequency	Percent
No	107	83.6
Yes	21	16.4
Total	128	100.0

Table 1.3: Drivers who underwent an eye exam before obtaining/renewing driver's license.

From this table, it shows that majority of the drivers examined subjectively indicated that they did not perform an eye exam before obtaining/renewing their driver's license.

Driving Experience	Frequency	Percent
1-5 years	17	13.3
6-10 years	30	23.4
11-15 years	31	24.2
16-20 years	24	18.8
>20 years	26	20.3
Total	128	100.0

Table 1.4: Driving experience of the participants of the study.

This table indicates that majority of the drivers had 6-10 years driving experience in contrast to drivers within the age range of 16-20; who were considered to be part of the minority.

Involved in a RTA in the last 5 years	Frequency	Percent
No	87	68.0
Yes	41	32.0
Total	128	100.0

Table 1.5: Drivers involvement in a RTA within the last 5 years.

From this table, it is observed that majority of the drivers were not involved in a RTA in the last five years.

Area in which driving is frequently done	Frequency	Percent
Couva/ Tabaquite/ Talparo/ Chaguanas	15	11.7
Diego Martin/ Port- of-Spain/Chaguaramas	21	16.4
Penal/Debe/ San-Fernando	25	19.5
Princes Town/ Rio Claro/ Mayaro/ Manzanilla	25	19.5
Tunapuna/ Arima/ Sangre-Grande/Toco	23	18.0
Siparia/ Cedros/ La Brea	19	14.8
Total	128	100.0

Table 1.6: Areas in which driving is most commonly done.

From this table, it is clear that majority of drivers equally commute or use the roadways in Penal/Debe/San-Fernando and Princes Town/Rio Claro/ Mayaro/ Manzanilla.

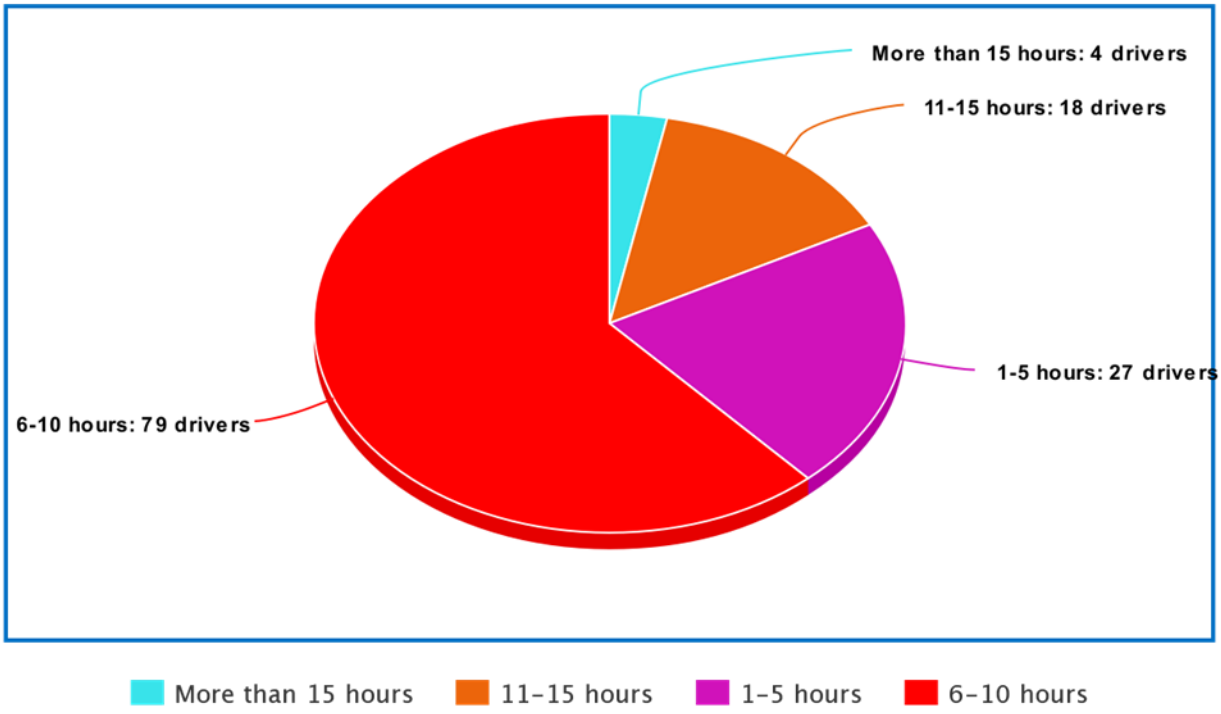

Figure 2.0: Average duration of time spent driving.

From the pie chart illustration, it can be observed that majority of drivers subjectively drive 6-10 hours on a daily basis with few drivers spending more than 15 hours on the roadway.

LogMar Score	Frequency OD	Percent OD	Frequency OS	Percent OS	Frequency OU	Percentage OU
-0.1 - 0.0 LogMar	47	36.7	47	36.7	54	49.2
0.02 - 0.1 LogMar	36	28.1	41	32.0	38	29.7
0.12 - 0.2 LogMar	16	12.5	13	10.2	8	6.3
0.22 - 0.3 LogMar	16	12.5	22	17.2	20	15.6
>0.32 LogMar	13	10.2	5	3.9	8	6.3
Total	128	100.0	128	100	128	100

Table 1.7: LogMar Visual Acuity Scores the Right Eye (OD), Left Eye (OS) and Both Eyes (OU) with their respective frequencies.

VA score affected by Glare	Frequency OD	Percent OD	Frequency OS	Percent OS
No	93	72.7	84	65.6
Yes	35	27.3	44	34.4
Total	128	100.0	128	100.0

Table 1.8: Indicating if the drivers VA score; OD or OS was affected with the presence of glare.

From the table, it can be observed that majority of the drivers examined, had a VA of -0.1 to 0.0 LogMar in the Right Eye, Left Eye and with Both eyes being opened.

Log Contrast Sensitivity Score	Frequency OD	Percent OD	Frequency OS	Percent OS	Frequency OU	Percent OU
<0.48 (Profound)	1	0.8	1	0.8	1	0.8
0.52 - 1.00 (Severe)	7	5.5	11	8.6	7	5.5
1.04 - 1.48 (Moderate)	34	26.6	15	11.7	17	13.3
1.52 - 1.76 (Normal)	38	29.7	51	39.8	42	32.8
1.72 - 1.92 (Excellent)	48	37.5	50	39.1	61	47.7
Total	128	100.0	128	100.0	128	100

Table 1.9: Log Contrast Sensitivity Score for the Right Eye (OD), Left Eye (OS) and Both Eyes (OU) with their respective frequencies.

It can be observed from the table that; majority of the drivers were considered to have an excellent log contrast sensitivity score, with one driver being considered to have profound contrast sensitivity impairment.

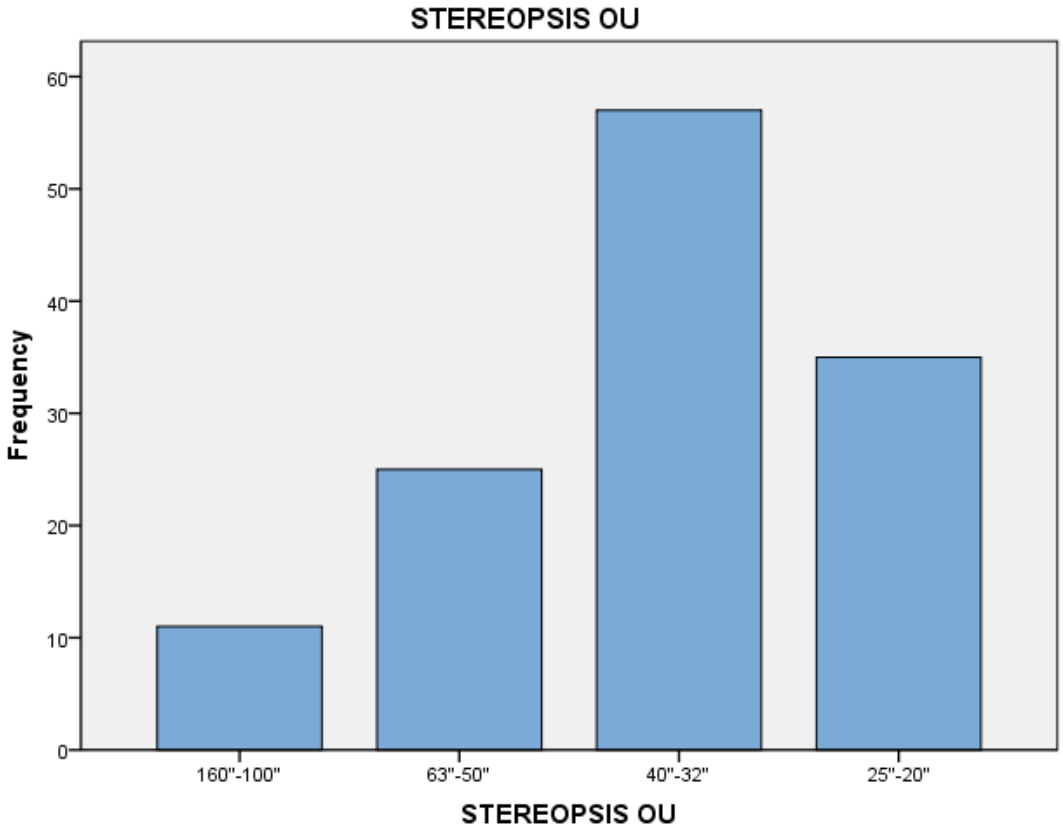

Figure 3.0: Bar graph showing the frequency and distribution Drivers' Static Stereoscopic Visual Acuity.

From the bar-graph, it can be seen that majority of the drivers had a binocular static stereoscopic value of 40'' – 32'' with few drivers having severe impairment, scoring 160''- 100''.

Figure 4.0: Bar graph indicating the number of drivers that missed > OR < 13 Ishihara Plates.

The bar-graph indicates that majority of the participating drivers missed less than 13 Ishihara Pseudoisochromatic Plates.

Presence/Absence of Abnormalities anteriorly	Frequency	Percent
No abnormalities seen	115	89.8
Abnormalities seen	13	10.2
Total	128	100.0

Table 2.0: Showing the frequency of Anterior Abnormalities detected on either eye.

From the table above, it is observed that no anterior ocular abnormalities were detected in a vast majority of the study population.

Presence/Absence of Abnormalities posteriorly	Frequency	Percent
No Abnormalities seen	111	86.7
Abnormalities seen	17	13.3
Total	128	100.0

Table 2.1: Showing the frequency of Posterior Abnormalities on either eye.

The table above shows that a total of 17 drivers had some degree of posterior ocular pathology being detected, which was referred to the UWI Optometry Clinic for further analysis.

IOP Range	Frequency OD	Percent OD	Frequency OS	Percent OS
5-10mmHg	11	8.6	18	14
11-15mHg	72	56.3	62	48.4
16-20mmHg	41	32.0	44	34.3
21-25mmHg	4	3.1	4	3.1
Total	128	100.0	128	100.0

Table 2.2: Showing the distribution of IOP's in the OD and OS of drivers.

According to the table above, it can be seen that a vast majority of the drivers examined for this study had an IOP range between 11 - 15mmHg, in both the OD and OS.

IOP > or < 22mmHg	Frequency	Percent
Less than 22mmHg	120	93.8
Greater or equal to 22mmHg	8	6.3
Total	128	100.0

Table 2.3: Further categorical classification of the IOP's.

From this table, which further classifies the recorded IOP, it can be seen that a total of 8 drivers had an IOP greater than 22mmHg; which was considered to be abnormal in this research.

VA score improved with Pinhole	Frequency	Percent
No	20	15.6
Yes	108	84.4
Total	128	100.0

Table 2.4: Indicating whether or not pinhole improved the Visual Acuity.

From the table above indicates that more than three-quarters of the drivers had a visual acuity improvement when they looked through a pinhole.

Effect of Visual Function and Occurrence of RTA

LogMar Score OU	**Had a RTA in the last 5 years**		**Total**
	No	**Yes**	
-0.1 - 0 LogMar	40	14	54
0.02 - 0.1 LogMar	27	11	38
0.12 - 0.2 LogMar	7	1	8
0.22 - 0.3 LogMar	12	8	20
> 0.32 LogMar	1	7	8
Total	87	41	128

Table 2.5: Cross-Tabulation analysis of Binocular VA and If the driver had been involved in a RTA in the last 5 years.

From the table above, it can be observed that drivers who had a VA of -0.1 to 0.0 LogMar were mostly involved in a RTA in the last 5 years in comparison to drivers with a worse VA score.

VA reduced with glare in either eye	Had a RTA in the last 5 years		Total
	No	**Yes**	
No	60	24	84
Yes	27	17	44
Total	87	41	128

Table 2.6: Cross-Tabulation analysis of whether VA was negatively affected with the presence of glare and if the driver had been involved in a RTA in the last 5 years.

From the table above, it can be observed that a total of 17(13.2%) drivers who had a VA score reduced with glare was involved in a RTA in the last 5 years.

Log CS Score OU	Had a RTA in the last 5 years		Total
	No	Yes	
<0.48 (Profound)	0	1	1
0.52 - 1.00 (Severe)	1	6	7
1.04 - 1.48 (Moderate)	4	13	17
1.52 - 1.76 (Normal)	30	12	42
1.72 - 1.92 (Excellent)	52	9	61
Total	87	41	128

Table 2.7: Cross-Tabulation of Binocular Log CS score and if the driver had been involved in a RTA in the last 5 years.

The table above which cross tabulates drivers who were involved in a RTA in the last 5 years; indicates that drivers who had a moderate Log CS score, were most frequently involved in a RTA.

No. of Ishihara Plates missed	Had a RTA in the last 5 years		Total
	No	Yes	
Less than 13 Plates Missed	80	26	106
More than 13 plates missed	7	15	22
Total	87	41	128

Table 2.8: Cross-Tabulation of the driver's ability to detect > or < 13 Ishihara plates and if the driver had been involved in a RTA in the last 5 years.

The table above which cross tabulates drivers who were involved in a RTA in the last 5 years; indicates that drivers who missed less than 13 Ishihara plates, were most frequently involved in a RTA as compared to drivers who missed more than 13 Ishihara plates.

Stereopsis OU	Had a RTA in the last 5 years		Total
	No	Yes	
160" - 100"	6	5	11
63" - 50"	12	13	25
40" - 32"	40	17	57
25" - 20"	29	6	35
Total	87	41	128

Table 2.9: Cross-Tabulation of the drivers' Static Stereoscopic Acuity and if the driver had been involved in a RTA in the last 5 years.

The table above which cross tabulates drivers who were involved in a RTA in the last 5 years and stereoscopic acuity; indicates that drivers who had a recorded stereoscopic acuity of 40'' – 32'' were the ones who were most commonly involved in a RTA.

Assessing the Knowledge of Drivers

Aware of having colour vision problems	Frequency	Percent
No	45	35.2
Yes	83	64.8
Total	128	100.0

Table 3.0: Shows the drivers response to being aware about colour vision problems.

This table indicates that majority of the drivers were aware of persons having colour vision problems.

Affected by glare	Frequency	Percent
No	50	39.1
Yes	78	60.9
Total	128	100.0

Table 3.1: Shows the drivers subjective response to being affected by glare on the roadway.

From the table above, it can be observed that approximately two-thirds of the drivers self-reported being affected by glare on the roadway.

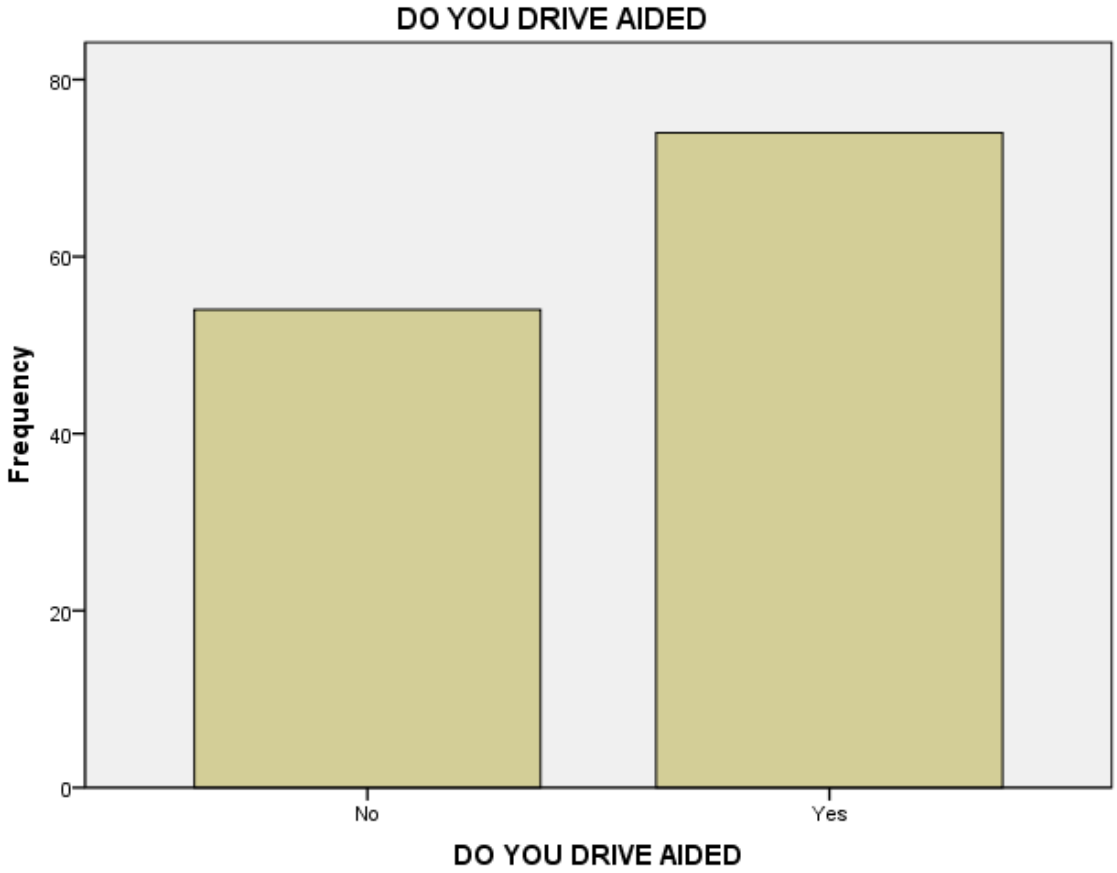

Figure 5.0: Indicates the prevalence of drivers that drive unaided and aided on the roadway.

From the bar-graph above, it can be seen that a vast majority of the drivers that utilises the roadway; drive aided via either contact lenses, spectacles or in some cases, tested sunglasses.

CHAPTER FIVE: DISCUSSION OF STUDY

5.1 Discussion

Age, Gender and Ethnic Distribution: This study which consisted of 128 drivers, was comprised of 63 females and 65 males, i.e. 49.2% females and 50.8% males respectively. The drivers had an age range from 20 years to 70 years, with most of the population being within the age range of 20-30, who accounted for 27.3% of the population which was followed by drivers in the age range of 31-40, which contributed to approximately 25.7% of the sampled driving population. In terms of ethnic background of the population, it is observed that 41.4% of the drivers consider themselves to be Afro-Caribbean whereas 38.38% consider themselves to be Indo-Caribbean **(Figure 1.0, Tables 1.0-1.1)**.

Cross data analysis between age and RTA in the last 5 years showed that majority of the RTA (26.8%) was caused by drivers within the age range of 31-40 followed by drivers within the age of 20-30 and 51-60 which both equally contributed to 48.7% of the RTA. Cross tabulation analysis also revealed that 61% of the RTA in the last 5 years occurred with a male driver as well as the majority (46.3%) of the RTA being related to the Afro-Caribbean ethnic group. However, Chi-Square data analysis showed no significance between age and the occurrence of RTA in the last 5 years ($p>0.05$) in the 95% confidence interval within the 0.05 significance level and a Cramers-V score of 0.14 amplifies that the association is weak. These findings go against the findings from Kusi et al as well as Egboka et al where majority of the subjective recorded RTA occurred with drivers within the age range of 40-59. **(Figure 2.0, Tables 1.4-1.6)**

Level of Education: Apart from the 5.4% of the population having their highest education to be that of the primary (7 year education level) level, 48.4% either graduated or still enrolled in

a tertiary level institute followed by 28.9% having received a CAPE diploma/ A' Level qualification which is the highest level of secondary education (14 years of education duration) and 16.4% having received a Caribbean Secondary Education Certificate (12 years of education) **Table 1.2**. Crossed table data analysis revealed that most of the drivers (48.7%) who had been involved in an RTA in the last five years had Tertiary Education or were currently involved. Where, 39% of the accidents occurred with the drivers whose highest level of education is CSEC and CAPE/A 'Levels; where they each accounted for 19.5% of the RTA that occurred in the last 5 years.

Duration and Area of Driving: With most, 24.2% of the sampled population having 11-15 years driving experience followed by those having 6-10 years (23.4%). Crossed Table data analysis revealed that majority of the recorded RTA (26.8%) that occurred in the last 5 years involved drivers who had more than 20 years of driving experience. Followed by those having 11-15(22%) and 16-20(22%) driving experience. This finding is different from the study conducted in Odisha India, where it was revealed that most of drivers (37.94%) had more than 20-years driving experience [10]. **(Figure 2.0, Tables 1.4-1.6).**

From **Table 1.6** it can be seen that most of the commuting done by the drivers are done in the areas of Penal/Debe/San-Fernando and Princes Town/Rio Claro/Mayaro/Manzanilla which both areas had 19.5% of the drivers mostly commonly using those routes, therefore 39% of the population use these two routes, which is then followed by the area Tunapuna/Arima/Sangre-Grande/Toco which had approximately 18% of the driving population using this route. Crossed Tabulation Data analysis showed that majority (24.4%) of the RTA that occurred in the previous 5 years, occurred in the areas of Tunapuna/ Arima/ Sangre-Grande/Toco.

On average it noticed that 61.7% of the drivers spend at least 6-10 hours on the roadway, which crossed data table analysis also showed that majority of the RTA (65.9%) occurs with individuals that spend 6-10 hours driving.

Having an eye exam before obtaining/renewing license and history of RTA: From the 128 drivers examined, only 21 (16.4%) of the drivers had an eye exam prior obtaining or renewing their license which ultimately meant majority(83.6%) had no eye exam before being legally allowed to drive on the road, **Table 1.3**, which is contradictory to the findings obtained by Kusi et al which was conducted in the central region of Ghana; where it was revealed that 89.4% of their study population(465 drivers) performed an eye exam before obtaining or renewing their license.

From **Table 1.5** it can be seen that majority of the driver that participated in this study, 68% was not involved in a RTA in the last five years. A chi square test was done, where a p-value of 0.242 was obtained with the significance level 0.05, in the 95% CI. Which meant that there was there was no real relationship between having an eye exam and being involved in a RTA; but with a Cramer V score of 0.103; indicates that the relationship is weak.

Drivers Vision: The majority of drivers (78.1%) had a binocular vision better than 0.2LogMar (6/9 Snellen Acuity) with 42.2% of the drivers scoring between -0.1 Logmar to 0.0 LogMar followed by 29.7% of the drivers being able to see within the 0.02 LogMar and 0.1 LogMar, Table 1.9. The Visual Acuity of 77.3% of the drivers were improved with the use of pinhole which ultimately suggested that these drivers had a significant refractive error. This finding is similar to the research findings discovered by Kshatri et al [10] where it was discovered that refractive error was the most common form of ocular morbidity as well as the APEDS study [12].

On performing a Chi-Square test on the VA, it was further categorized into candidates having a binocular VA better than 0.2LogMar or worse than 0.2LogMar. The χ^2 test revealed that there is a relationship between the VA being worse than 0.2LogMar and the occurrence of RTA in the last 5 years($p<0.05$), however a Cramers V score of 0.244 implies that there is a weak relationship, which goes in accordance to the findings from Odisha India done by Kshatri et al[10] where it was discovered there was not any significant relationship between refractive error and RTA.

In furtherance, the Visual Acuity of the 34.4% of the drivers were affected by the disability glare test. χ^2 test showed revealed that there is no association with the VA being affected by glare and RTA in the last 5 years($p>0.05$), however a Cramers-V score of 0.339 implies that the relationship is not weak; but moderate.

Contrast Sensitivity: Binocular Normal to Excellent Contrast Sensitivity was recorded in 86 drivers (67.1%) with 48(37.5%) of the drivers being considered to have an excellent ability to see in low contrast which carried a range of 1.72 LogMar-1.92LogMar. However, 42 (32.8%) of the drivers studied; scored below the normal limit of 1.52 LogMar, **Table 1.9**. Cross table data analysis revealed that majority (31.7%) of the RTA occurred with drivers who was considered to have moderate contrast sensitivity (LogMar 1.04 – 1.48). Chi-Square, χ^2 test, with a LogMar score less than 1.52 being considered to be normal; revealed that there is an association, ($p<0.05$). This relationship was amplified with a Cramers V score of 0.442. This finding is similar to the one obtained at the North-Central State of Nigeria conducted by Egboka et al[11], where it was discovered that there was also an association with Contrast Sensitivity Impairment and RTA.

Colour Vision: According to Professor Emeritus of the University of Tokyo, who states that if less than 13 Ishihara Plates are read accurately within the normal testing limits; the

individual is regarded as colour vision deficient [23]. On assessing the drivers colour vision with the Ishihara colour vision plates, more than three quarter of the population (82%) missed less than 13 plates to no plates which meant 18% of drivers were unable to correctly identify 13 Ishihara Plates, **Figure 4.0**; this finding identifies more colour vision impaired drivers in comparison to the research done by Tang et al [13] where only 9.9% of the drivers were found to have colour vision defects. Cross table tabulation analysis revealed that 63.4% of the drivers who had been involved in a RTA in the last 5 years missed were considered to be colour vision deficient. Chi-Square, χ^2 test, CI 95% revealed that there is a relationship between incorrectly identifying 13 Ishihara plates and being involved in a RTA in the last 5 years($p<0.05$) in which it had a significant relationship having a Cramers V score of 0.353. This finding partially goes against the research findings conducted in the South-Western region of Nigeria by Omolase et al [10]; where there was not any significant association between abnormal colour vision and RTA, but partially goes in accordance to the finidings obtained in the North Central State of Nigeria done by Egboka et al [11].

Stereopsis: From **Figure 3.0** it is seen that majority of the drivers (44.5%) were found to have a stereoscopic acuity between 40'' to 32'', followed by 35 drivers (27.3%) having a score between 25'' to 20''.A total of 36 (28.1%) drivers were found to have a stereoscopic greater than 50'' with a total of 18 drivers being involved in a RTA in the last 5 years whilst scoring less than 50'' of stereoscopic acuity, which follows the results obtained from Tang et al [13] where it was discovered that 18.5% of the drivers had a poor stereoacuity; with the researcher not identifying a value considered to be poor stereopsis. Chi-Square, χ^2 test revealed that there is no statistical relationship between having a stereoscopic acuity worse than 50'' and RTA occurrence in the last 5 years ($p>0.05$).

Anterior and Posterior Eye Health Examination

Intra-Ocular Pressure (IOP): A large portion of the sample, 56.3% had an IOP value between the 11-15mmHg interval followed by 32% of the driving population having a value ranging between 16-20mmHg.In further categorical analysis, a value of 22mmHg and higher being classified as abnormal and vice versa **Table 2.2**. Cross table data analysis showed that majority (87.8%) of the RTA in the last 5 occurred with drivers having an IOP less than 22mmHg.[24] Chi-Square, χ^2 test showed that there is no relationship existing between the IOP being greater than 22mmHg and RTA occurrence in the last 5 years. Unfortunately, there is no research evidence that can be related or argued against this point, as research into this category is almost non-existent; however it should be noted that in the Central region of Ghana; Kusi et al[24] only performed IOP measurements once there was a an enlarged vertical Cup-to-disc ratio or asymmetric discs; who did not indicate the number of participants fell into this category if any at all.

To assess the ocular health of each of the driver's eyes; the eyes were examined anteriorly and posteriorly; both with a handheld Ophthalmoscope. On the anterior examination, no abnormalities were seen on 89.8% of the 128 participants, with a total of 13 drivers showing some abnormalities detected anteriorly such as mild cases of blepharitis suspected cases of Keratoconus, Pinguelae and suspected for Cataracts. On examining the posterior structures, a total of 13.3% of the drivers had some degree of abnormality detected in either eye; with majority of the drivers having no abnormalities detected. Chi-Square, χ^2 test on both ocular examinations showed no relationship with RTA occurrence in the last 5 years, ($p>0.05$) in the 95% CI.

Assessing the driver's knowledge of eye-care more specifically when it comes to their driving ability; the questionnaire was utilized in its full entity. It revealed that a total of 45

drivers(35.1%) were unaware that colour vision/blindness could affect a person's driving capability, 78 drivers (60.9%) had self-reported glare problems whilst driving, which is similar to the findings obtained by Tang et al[13].

This study also revealed that a total of 56 drivers(43.8%) of drivers never had an eye exam which contradicts the data obtained from Omolase et al, 2012 [10];which indicated that most of their drivers did not have an ocular assessment. It was also revealed that a total of 74(57.8%) of the drivers use some degree of eyewear whilst driving to aide in their comfort.

5.2 Conclusion

In this non-invasive prospective study, one-hundred and twenty-eight (128) drivers with a valid Trinidad and Tobago driver's license whilst meeting the inclusion criteria had their vision screened. An association was found to be present with colour deficient drivers and drivers who have a binocular log contrast sensitivity score greater than 1.52 **with** RTA occurrence in the last 5 years. Additionally, it was discovered that the main cause of visual function impairment of drivers is due to refractive error, where the 77.3% of the study population had some sort of improvement with the utilisation of the pinhole, as well as it was discovered that only 16.4% of the drivers having an ocular examination prior obtaining their driver's license.

Many studies as seen in the literature review have indicated that visual acuity is, at best very weakly linked to RTA involvement and therefore a poor screening test for identifying drivers who are at-risk for future RTA, and this study follows the trend that is indicated by other studies.

5.3 Limitations of Study

This study consisted of several limitation factors; the major one having a sample size that does not properly and accurately represent the driving population in Trinidad as the study was done in 3 month period due to the COVID-19 pandemic.

The flashlight used in performing the disability glare test was considered to be that of a diffuser type rather than a focused beam of light. This study was based on respondents' self-reported road traffic crash involvement. In order to examine the anterior eye; a hand help ophthalmoscope was used; which ultimately meant that the anterior structures of the eye were not viewed in its detailed structures. Having to screen the drivers at different locations ultimately meant that the Lux values of each room was unique.

There is currently no report from the Ministry of Transport or Legal Affairs on RTA in relation to traceable to individual licensed drivers in Trinidad.

5.4 Recommendations

Whilst on the road-way, no object is stationary at one point relative to the driver; therefore dynamic visual acuity should be tested with a 3m LogMar chart instead of static visual acuity as it will give a more reliable 'vision score' of when objects are in motion. In order to properly examine the anterior eye in its full detail, a slit lamp or handheld slit lamp should be used for future research.

With respect to the research being focused on being the backbone to new driving regulations being developed, there is a need to adopt study designs and to develop screening tests

that can be more readily translated into licensing policies. Based on these, it is necessary to implement a mandatory eye test for potential applicants for driving license as well as those who are renewing. This to an extent will contribute greatly in reducing the frequency of RTAs on the roads. A strong collaboration between the Trinidad and Tobago Optometrists Association(TTOA) along with the Trinidad and Tobago Medical Board(TTMA) and the Licensing Authority of Trinidad and Tobago (LATT) and by the extension the Ministry of Legal Affairs is therefore indispensable and needed in ensuring proper screening before issuance of driving license both at first time and during renewals.

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APPENDICIES

THE UNIVERSITY OF THE WEST INDIES
ST AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
CAMPUS RESEARCH ETHICS COMMITTEE
TEL.: (1-868) 662-2002 ext. 82755 E-mail: campusethics@sta.uwi.edu

December 19 2019

Kingsley Kene Ekemiri (Prashan Seepersad ,Krista Seetaram)
UWI Optometry, Gordon Street, St. Augustine
Email: kingsley.ekemiri@sta.uwi.edu

Dear Kingsley Kene Ekemiri,

Ref: CREC-SA.0068/10/2019

Title: The Visual Status of Commercial Vehicle Drivers in Trinidad.

I am pleased to advise that your application for research on the above captioned topic has been approved on behalf of Campus Research Ethics Committee, St. Augustine.

Sincerely,

Surendra Arjoon (Prof.)
Chairman
Ethics Committee

Attachment 1: Showing the UWI Ethics Chairman giving the approval.

This document was approved by Campus Ethics Committee on:
December 19 2019
This document expires on:
2020-04-17

If I am asked to consent to participate as a subject in a research study involving a medical experiment, or if I am asked to consent for someone else, I have the right to:

1. Learn the nature and purpose of the experiment (also called "study" or "clinical trial").
2. Receive an explanation of the procedures to be followed in the study, and any drug or device used.
3. Receive a description of any discomforts and risks that I could experience from the study.
4. Receive an explanation of any benefits I might expect form the study.
5. Learn about the risks and benefits of any other available procedures, drugs or devices that might be helpful to me.
6. Learn what medical treatment will be made available to me if I should be injured as a result of this study.
7. Ask any questions about the study or the procedures involved.
8. Quit the study at any time, and my decision will not be used as an excuse to withhold necessary medical treatment.
9. Receive a copy of the signed and dated consent form.
10. Decide to consent or not to consent to a study without feeling forced or obligated.

If I have questions about a research study, I can call the contact person listed on the consent form. If I have concerns about the research staff, or need more information about my rights as a subject, I can contact the Principal Investigator, The University of the West Indies at: kingsley.ekemiri@sta.uwi.edu, +1(868)735-2586.

By signing this document, I agree that I have ready and received a copy of this document.

Signature of Subject or Legal Representative _____ Date _____

REQUEST FOR PERMISSION TO USE AN INDIVIDUAL'S PRIVATE HEALTH INFORMATION

Name of Study: The Visual Status of Commercial Vehicle Drivers in Trinidad.

Investigators: Kingsley Kene Ekemiri, Prashan Seepersad ,Krista Seetaram

Attachment 2: Document in which participant gave written consent to partake in the research.

Notes: I—Special attention should be directed to distant vision.

II—Special attention is directed to the condition of the arms, hands, legs and joints of the upper and lower extremities.

The applicant is responsible for the payment of any fee in connection with the examination

MEDICAL TEST FOR DRIVING PERMIT

FORM OF MEDICAL CERTIFICATE FOR AN APPLICANT FOR A LICENCE TO DRIVE MOTOR VEHICLES

In the case of suspected medical unfitness it is important that the Licensing Authority be satisfied on the following points before the grant of a driving permit:

	Reply to be given in this column
1. Is the applicant, to the best of your judgment, subject to epilepsy, vertigo or any mental ailment likely to affect his efficiency?	
2. Does the applicant suffer from any heart or lung disorder which might interfere with the performance of his duties as a driver?	
3. What is the Blood pressure reading? (Both systolic and diastolic readings should be given).	
4. *(a)* Is there any defect of vision? *(See* Note I).	*(a)*
(b) If a defect of vision is revealed on examination, give acuity of vision by Shellen's Test.	*(b)* R.E. ..... L.E. ..... without glasses. R.E. ..... L.E. ..... with glasses.
(c) Do you consider that the applicant should wear glasses when driving?	*(c)*
(d) Is there any defect of hearing?	*(d)*
5. Has the applicant any deformity or loss of members? If so, would it interfere with the efficient performance of his duties as a driver? *(See* Note II).	

Attachment 3: The rule required by the Ministry of Legal Affairs respective of vision and driving in Trinidad and Tobago.

TRINIDAD AND TOBAGO CHAMBER OF INDUSTRY AND COMMERCE

www.chamber.org.tt

The Chamber means **BUSINESS**

NOTICES - 08/01/20

See below for details on :-

- CONTACT Vol 19 No 4 - December 2019: 2030 - The Next Decade
- **The University of The West Indies Optometry Clinic: Eye Screening**

Attachment 4: Showing the Membership of TTCIC receiving the flyer/notice which was also posted and shared on Social Media.

Type of Vehicle being used	Had a RTA in the last 5 years		Total
	No	Yes	
Motor Vehicle	61	32	93
Goods Vehicle	17	4	21
Hiring Car / Taxi	4	2	6
Maxi-Taxi	5	3	8
Total	87	41	128

Attachment 5: Table Indicating vehicles commonly used by the drivers and their involvement in RTA in the last 5 years. The categories of the vehicle were classified in accordance to Act 48:50

Demographic Data

1. In what age category do you belong?
   - ◯ 21 - 30
   - ◯ 31 - 40
   - ◯ 41 - 50
   - ◯ 51 - 60
   - ◯ 61- 70

2. Gender
   - ◯ Male ◯ Female

3. Which of the following ethnic groups do you consider yourself being a part of?
   - ◯ White or Caucasian
   - ◯ Hispanic or Latino
   - ◯ Indo- Caribbean
   - ◯ Afro- Caribbean
   - ◯ Other (Please specify) _____

4. At what age did you finish school?
   - ◯ 11years ◯ 16 years ◯ 18 years ◯ 22 years
   - ◯ Other (Please specify) _____

Driving Data

5. In what year did you first obtain your drivers license?

   _____

6. Did you ever go through an eye exam prior to renewal or obtaining your drivers license?
   - ◯ Yes ◯ No

7. What type of vehicle do you drive?
   - ◯ Motor Vehicle ◯ Goods Vehicle ◯ Taxi ◯ Maxi-Taxi
   - ◯ Other (Please specify) _____

8. Approximately, what time of the day do you drive? (Please tick one)
   - ◯ 12:00 midnight – 6:00 am
   - ◯ 6:00 am- 12:00 noon
   - ◯ 12:00 noon- 6:00 pm
   - ◯ 6:00 pm- 12:00 midnight

9. On average, how many hours a day do you drive on the roadway?
   ◯ 4-5 hours ◯ 6-10 hours ◯ 11-15 hours ◯ 15+ hours

10. How many days per week do you drive?
   ◯ 1- 3 days ◯ 4- 6 days ◯ More than 6 days

Subject Code: _____

11. In what area/s do you usually drive in?
   ◯ Couva/ Tabaquite/ Talparo/ Chaguanas
   ◯ Deigo Martin/ Port- of- Spain
   ◯ Mayaro/ Rio Claro
   ◯ Penal/ Debe/ San- Fernando
   ◯ Princes Town
   ◯ Sangre Grande/ Arima
   ◯ San Juan/ Laventille
   ◯ Siparia
   ◯ Tunapuna/ Piarco
   ◯ Other (Please specify) _____

12. Have you ever gotten into a road traffic related accident in the past 5 years?
   ◯ Yes ◯ No

Visual Comfort or Performance

13. Do you drive with prescription glasses or contact lens?
    ◯ Yes ◯ No

14. Does glare affect you while driving?
    ◯ Yes ◯ No

15. Can you easily identify the colors of the traffic light while driving?
    ◯ Yes ◯ No

16. If 'No' to question 15, which color/s do you have difficulty identifying?
    ◯ Red ◯ Yellow ◯ Green

17. On a scale of 1-10 how comfortable are you with your vision while driving?

1	2	3	4	5	6	7	8	9	10

Very Uncomfortable → Average → Very comfortable

18. Have you ever had an eye exam?
    ◯ Yes ◯ No

19. If 'Yes' to question 18, when was it done?
    ◯ 1- 2 years ago ◯ 3- 5 years ago
    ◯ More than 5 years ago

20. Are you aware that there are some individuals who cannot differentiate colors?
    ◯ Yes ◯ No

Attachment 6: Questionnaire used to obtain data on Socio-demographics, Driving experience and Visual Comfort.