ANALYSIS OF REFRACTIVE ERROR IN SONORA, MEXICO

By

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ABSTRACT

Background: This research study aims to classify the refractive error of a group of inhabitants of the state of Sonora, Mexico. Clinics were located in Empalme and Santa Maria, Sonora, Mexico. The ultimate goal is to allow better preparation for future mission trips to the same region. *Methods:* The data was collected over the course of 4 clinic days from patients presenting to a non-profit clinic sponsored by Volunteer's for Optometric Services to Humanity of Michigan. The volunteers collecting the data were Optometry students and Doctors of Optometry. The data was collected and analyzed. Confidentiality of the information was maintained, as identifying information was not included with refractive error data. *Results:* Females outnumbered males in this study. The most prevalent refractive error was simple hyperopia less than 2 diopters. The least common was mixed astigmatism. Close to half of the patients were presbyopic. A little over half received sunglasses. *Conclusion:* Future optometric missions may prepare using the data collected on this mission. Low hyperopic error is most prevalent and glasses selection may be adjusted accordingly to this fact. Against the rule astigmatism is most prevalent of all types of astigmatism and may also be considered when selecting lenses to bring on future missions.

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INTRODUCTION

Sonora is one of 31 federal states and is located in the northwest corner of Mexico. The United States borders Sonora to the North, and it is bordered by the states of Sinaloa to the south, Chihuahua to the East and the Sea of Cortez to the West. It is the second largest Mexican state with a land mass of 184.934 square kilometers.[1] Sonora consists of four different geographic regions including the Sierra Madre Occidental, Parallel Mountains and Valleys, the Sonoran Desert, and the coast of the Gulf of California. In 2000, Sonora had a population of 2,839,969, divided into 50.1% male and 49.9% female inhabitants. The state of Sonora is representative of 2.3% of Mexico's total population. Children under 5 years of age made up 9.5% of the population, children aged 5 to 14 made up 16.7%, 14.8% between 15 and 24, 26% between 25 and 49 years, and 10.8% of the population were over the age of 50 in the year 2000.[1]

Volunteer Optometric Services to Humanity International (VOSH) is a non-profit, apolitical, non-governmental organization dedicated to providing eye and vision care services for those below poverty level and without local access to eye care. VOSH international has 35 regional chapters and 25 student chapters in the United States, Canada, Honduras, India, Africa, South America, and the Netherlands. Volunteers include optometrists, optometry students, ophthalmologists, opticians, and other volunteers. Yearly, VOSH international participates in between 80 to 90 missions and serves in excess of 100,000 people. VOSH programs provide eyeglasses, treat eye disease, and refer patients for needed eye surgeries. In 2009, 11 of the 62 listed missions (17%) were to Mexico. The primary mission of VOSH international is to "facilitate the provision and sustainability of vision care worldwide to people who can neither afford nor obtain such care." In addition, VOSH has been partnered with the World Health Organization (WHO) since 2001 in a pledge to eliminate preventable blindness by the year 2020.[2]

The need for data outlining the refractive errors in a given location is important in many ways. First, it will improve the effectiveness of each mission trip by eliminating the number of unneeded equipment brought on the trip. Secondly, it increases the number of patients each mission trip will serve. Finally, it serves to provide an outline for future mission groups to effectively serve populations in the same area.

Refractive error can be divided into three simple groupings, and combinations of these three classifications encompass the refractive errors of a population. Myopia is synonymous for "near-sighted" and describes the condition in which light is focused before it arrives at the patient's retina, therefore the light hitting the retina is unfocused and results in subjective blur. In order to correct for a myopic refractive error, minus lenses are prescribed in order to diverge light in the appropriate degree so that it may focus on the retina. Myopia occurs when the patient has a longer than average eye or a stronger than average lens.[3]

Hyperopia is synonymous for "far-sighted" and describes the condition in which light is not focused before it arrives at the retina. Again, unfocused light results in perceived blur for the patient. Hyperopes commonly have shorter than average eyes or weaker than average lenses to focus light. Hyperopia requires the use of a convergent lens in order to bring the focus to the retina.[3]

Astigmatism is the condition in which the cornea contains different curvatures such that light is not focused in one spot but two. Generally, astigmatism is "regular" meaning that the two planes are perpendicular to one another and may be corrected by the use of corrective spectacles. Irregular astigmatism occurs when two planes perpendicular to one another cannot be identified, and the cornea is of an irregular shape.[3]

Patients may be classified according to refractive error in terms of hyperopia, myopia, and astigmatism. For instance, a patient whose refractive error is hyperopia with both focused points of light falling theoretically behind the plane of the retina are described as having compound hyperopic astigmatism (CHA) while a patient with both focused point of light falling before the retina would be classified as having compound myopic astigmatism (CMA). A patient with one point of focus ahead of the retina and one that falls behind would be classified as having mixed astigmatism (MA).[3]

Additionally, patients may present with the condition Presbyopia. Presbyopia refers to the loss of the ability to accommodate. With loss of accommodation comes an inability to read at near. When this occurs, convergent lenses (plus lenses) and needed at near in order to allow patients to read. In the United States, it is common for this loss of accommodation to occur between the ages of 40 and 50 years of age.[3]

METHODS

Data was collected from February 18-21, 2008. Patients were examined in free clinics in Guaymas, Mexico for the first two days and in Santa Maria, Mexico for the second two clinic days. Patients arrived of their own volition and filled out paperwork containing their age and occupation. They were then evaluated for visual acuity, refractive error, and ocular health. Refractive errors were documented utilizing the techniques of retinoscopy and subjective refraction with trial frames. Later, the data compiled on these dates was evaluated and compiled into useful charts and graphs in order to provide information as to the refractive errors of the population in San Carlos, Mexico.

RESULTS

In February 2008, 1800 patients were examined for refractive error in San Carlos, Mexico. The population was assessed for their refractive error and given a form to fill out including demographic information including occupation, age, and sex. Of 1800 total patients, 36.5% were male and 63.5% female (Table 1). Many occupations were represented with "housewife" leading at 41% of all patients examined. The second most prevalent occupation was "student" with 29.5% followed by "farmer" (8.5%). "Retired" and "unknown or unlisted" were both prevalent at a rate of 4.5%. Several occupations were tied for 1% prevalence including fisherman, grocer, welder, brick maker, and teacher. Slightly less prevalent were the occupations librarian, security, office worker, police officer, inside work, human resources, beaurocrat, truck driver, pensioner, maestro, iron worker, driver, handy man, sales, and store owner at 0.50% of the population. Age distribution was as follows: the most prevalent age range was from 6 to 10 years of age with a prevalence of 15.5% of those reporting. Closely following was the 46-50 age range with 15% and the 11 to 15 age range with 13.5% followed by the 41-45 age range with 10.5% of the population. The complete table of ages may be viewed in Appendix B along with a graphical representation of the age distribution. Overall, 32.5% of the population reporting was under the age of 20. The ages of 20-40 were represented at 11%. 37.5% of the population was between the ages of 40 to 60, and 21% of the population was over the age of 60.

Refractive error was analyzed according to eyes instead of patients due to the fact that refractive error varies in many patients between the two eyes. Of the myopic eyes examined, 64% had a refractive error of simple myopia 2 diopters or less. 17% of eyes had a refractive error between 2 and 5 diopters and 5% had a refractive error of simple myopia greater than 5 diopters. Of the compound myopic astigmats, 13% had a cylinder power less than 2 diopters and only 1% had a cylinder power greater than 2 diopters. Of the hyperopic patients examined, simple hyperopia less than 2 diopters was most prevalent at a rate of 67% followed by simple hyperopia greater than 2 D with 18%. Compound hyperopic astigmatism with cylinder less than 2 D accounted for 13% while compound hyperopic astigmatism with cylinder power greater than 2 D was prevalent at 2%. Blindness was prevalent at a rate of 1%. Mixed astigmatism was prevalent at a rate of 2% overall. When analyzing all refractive errors together, 33% of the population proved to be

emmetropic, 29% of eyes had simple hyperopia less than 2 diopters, 14% had simple myopia less than 2 diopters. Simple hyperopia greater than 2 diopters was next most common at a rate of 8% followed by compound hyperopic astigmatism with cylinder less than 2 diopters at 6%. Closely following are simple myopia between 2 and 5 diopters and compound myopic astigmatism with cylinder less than 2 diopters at 3% each. The least prevalent refractive errors may be viewed in Appendix B, refractive error graph. Of the eyes with astigmatic error, 52% were against the rule, 38% with the rule, and 10% at an oblique axis. Presbyopia was prevalent at a rate of 47% of the eyes examined with 26% of the presbyopic patients needing only single vision reading glasses or over-the-counter reading glasses. Of the patients seen, 55% received sunglasses either in addition to corrective lenses or alone for ultraviolet protection.

DISCUSSION

Once compiled, the results showed some important population tendencies that may be helpful in future refractive missions. Overall, women were seen more often than men during the clinic days. The most common occupation was housewife followed closely by student, farmer, and retired or unknown. Age distribution showed the largest percentage of patients were between the ages of 40 and 60 followed closely by the second largest percentage of patients under the age of 20. This is important for future refractive missions in planning for frame selection. With a 55% prevalence of presbyopia and the largest percentage of patients between 40 and 60, it is important to have a large supply of reading glasses. Of the presbyopic patients, 26% needed only single vision reading glasses. While planning refractive missions, it would be helpful to plan for roughly half of patients being presbyopic and half of those patients needing only over the counter single vision reading glasses.

Additionally, with the second most prevalent age range less than 20 years old, it is helpful to have roughly 30% of the glasses selection for children. On this particular mission, 55% of patients received sunglasses. Ideally, 100% of patients in the region would benefit from the use of sunglasses. This is one area in which this mission could have improved. However, when compiling the data, only forms indicating the need for sunglasses were counted as patients receiving sunglasses. In reality, dispensing technicians may have dispensed many more sunglasses than were recorded on the individual forms.

One third of the population had emmetropic refractive error. These are patients that would benefit from plano sunglasses. The next most prevalent refractive error was simple hyperopic error less than 2 diopters. Along with the need for single vision readers, it would be wise to being the highest proportion of low powered plus lenses. Second most prevalent was simple myopic refractive error. When planning for astigmatic error, against the rule was most prevalent with with the rule second most prevalent and oblique astigmatism least prevalent. When planning for myopic refractive error, approximately 65% of the glasses should be for simple myopia less than 2 diopters, 17% for myopes between 2 and 5 diopters, and 5% of lenses should be for myopes greater than 5 diopters. Compound myopic astigmatism with cylinder power less than 2 diopters was much more common at 13% of myopes than myopic astigmatism greater than 2

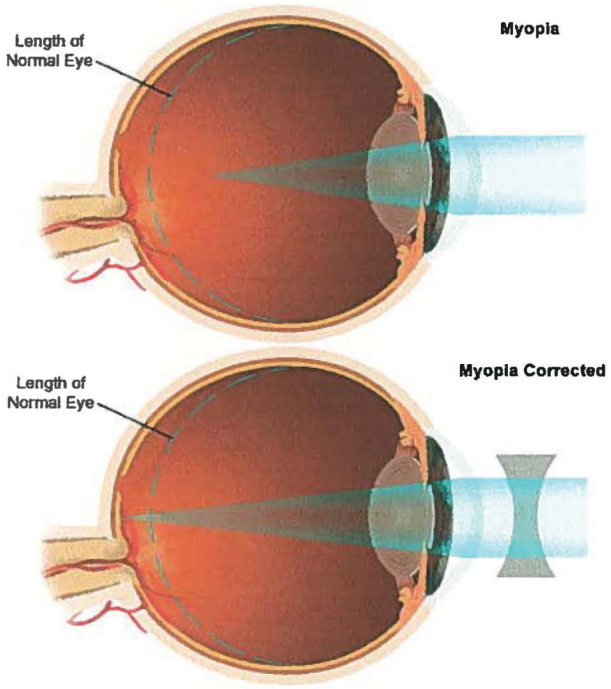
diopters. Approximately the same percentages apply to the hyperopic refractive errors as well. 67% of the hyperopic prescriptions should be of low (less than 2 diopters) plus power. 18% should be of power greater than 2 diopters, and the compound hyperopic errors should be divided accordingly to the rates of incidence (13% CHA with cylinder less than 2 diopters and 2% with cylinder greater than 2 diopters).

CONCLUSION

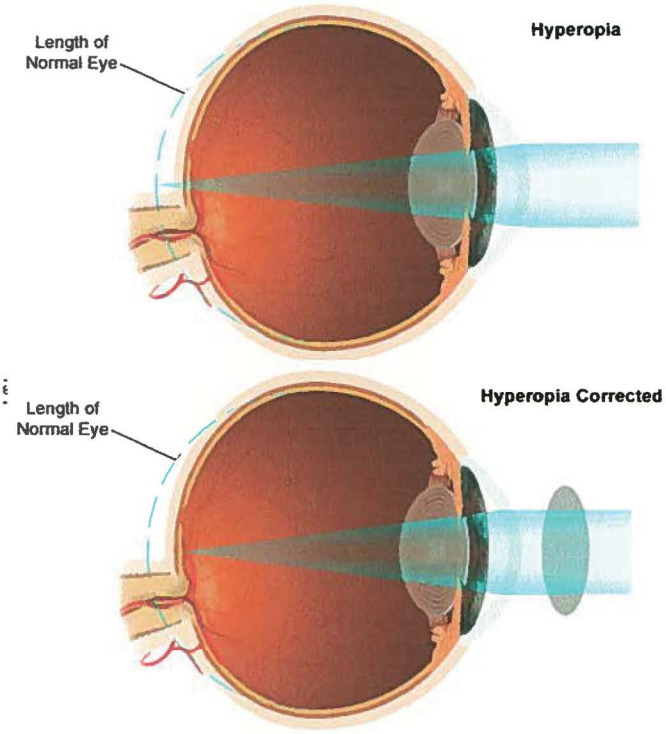
Overall, women patients report to the clinic at a greater rate than male patients. Children between the age of 6 and 10 make up the largest percentage of patients with adults between 46 and 50 second most common and children between the ages of 11 and 15 third most commonly seen. It is important to have a large selection of children's frames and an adequate proportion of reading glasses (bifocal and over the counter). Trip planners should approximate the number of patients to be seen and carry over the counter single vision reading glasses at a rate of 25% of the patients to be seen and bifocals at about 50% of the patients to be seen. Also, simple hyperopic refractive error less than 2 diopters is most prevalent and should be carried in larger quantities than any other refractive error. Second most common was simple myopic refractive error less than 2 diopters. Of the astigmatic correction, against the rule was more common than either with the rule or oblique astigmatism.

APPENDIX A- Photos

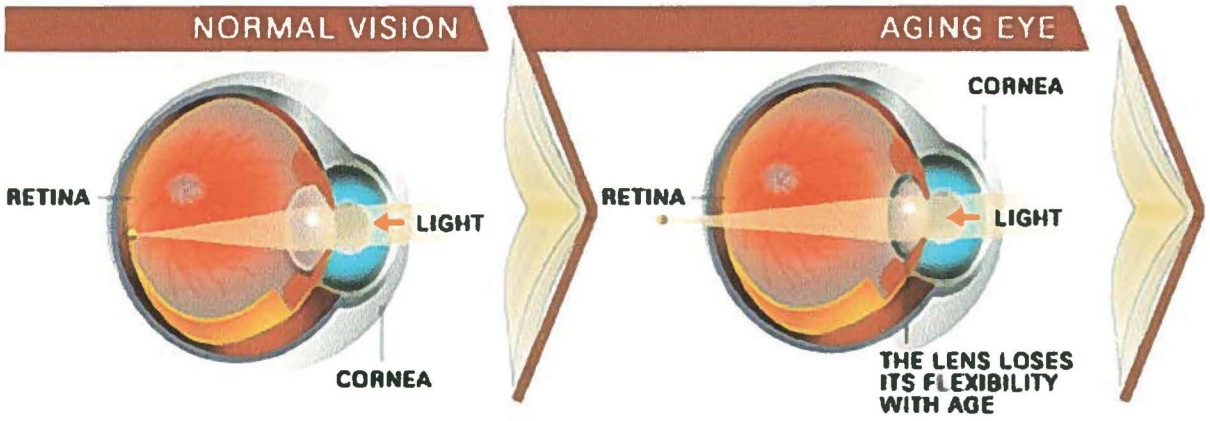
Picture 1: Map of the state of Sonora, Mexico.



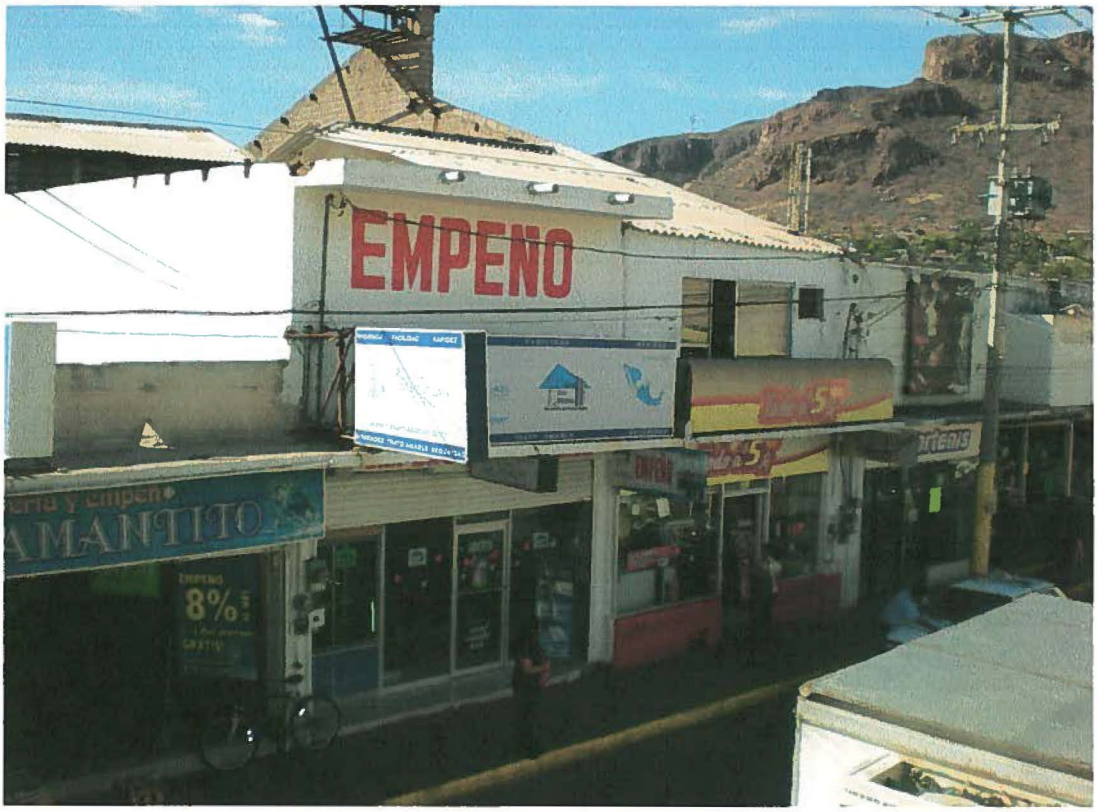
Picture 2: Myopia uncorrected (top) and after correction with a divergent (minus) lens (below)



Picture 3: Hyperopia uncorrected (top) and with a convergent lens in place (bottom)



Picture 4: Presbyopia explained.

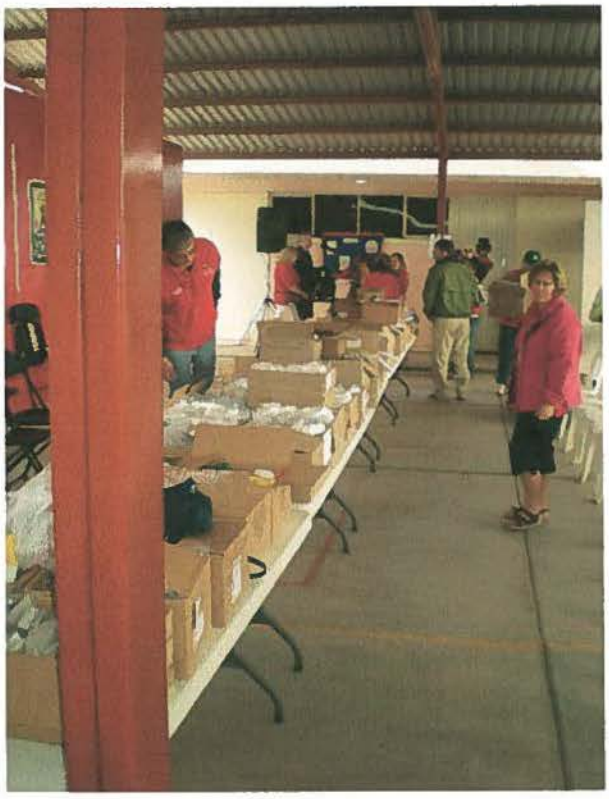


Picture 5: Market in downtown Guyamas, Sonora, Mexico

Picture 6: Clinic site in Guaymas, Sonora, Mexico

Picture 7: Equipment used in clinic in Santa Maria, Sonora, Mexico

Picture 8: Student doctors providing glasses for citizens of Sonora, Mexico.



Picture 9: Dispensary at Guaymas, Sonora, Mexico

Appendix B- Tables and Graphs

SEX

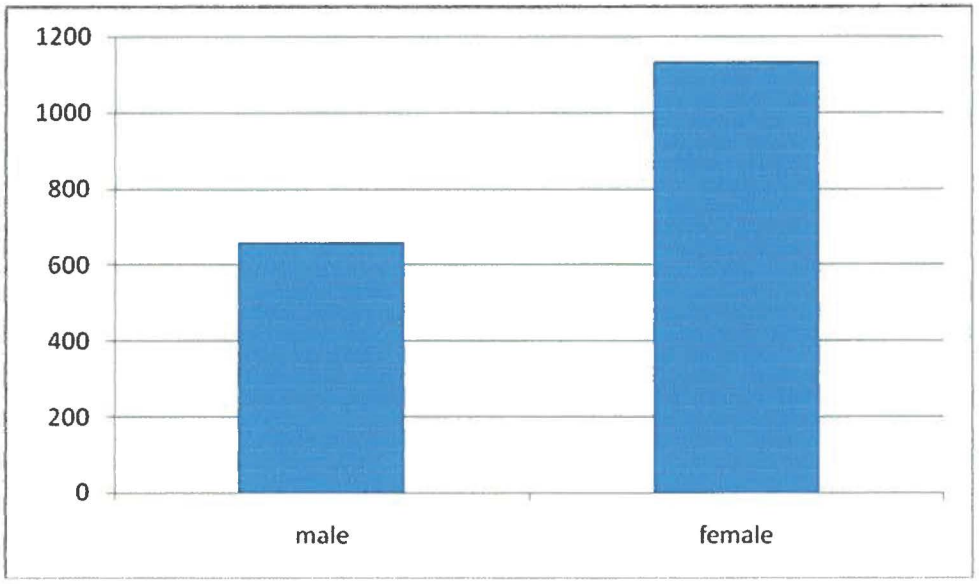


Table 1: Table showing sex distribution of patients reporting to clinics in San Carlos, Mexico.

OCCUPATION

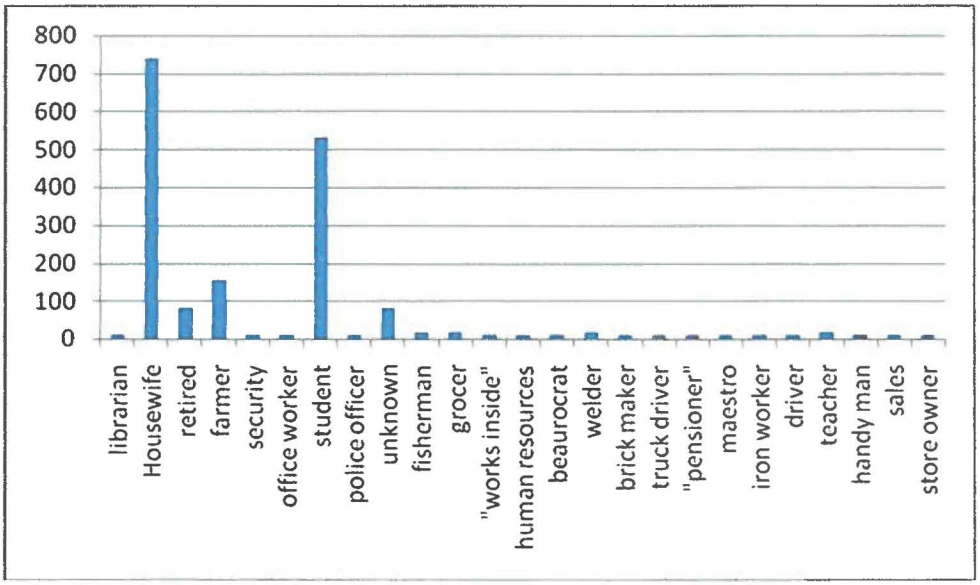


Table 2: Distribution of occupation in San Carlos, Mexico population.

AGE

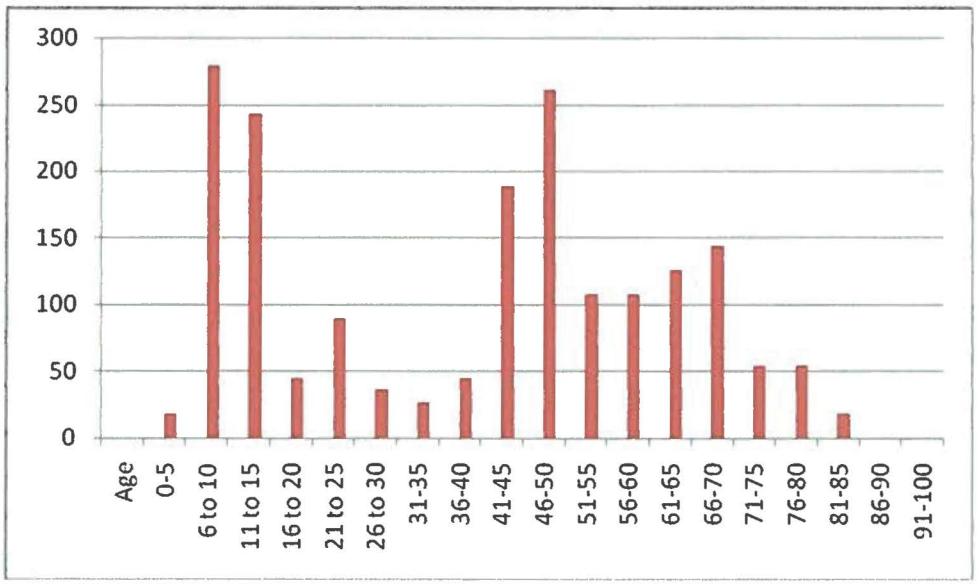


Table 3: Graph showing distribution of age in San Carlos population reporting to eye clinics

Age	
0-5	1.00%
6 to 10	15.50%
11 to 15	13.50%
16 to 20	2.50%
21 to 25	5%
26 to 30	2%
31-35	1.50%
36-40	2.50%
41-45	10.50%
46-50	15%
51-55	6%
56-60	6%
61-65	7%
66-70	8%
71-75	3%
76-80	3%
81-85	1%
86-90	0%
91-100	0%

Table 4: Table of Age distribution

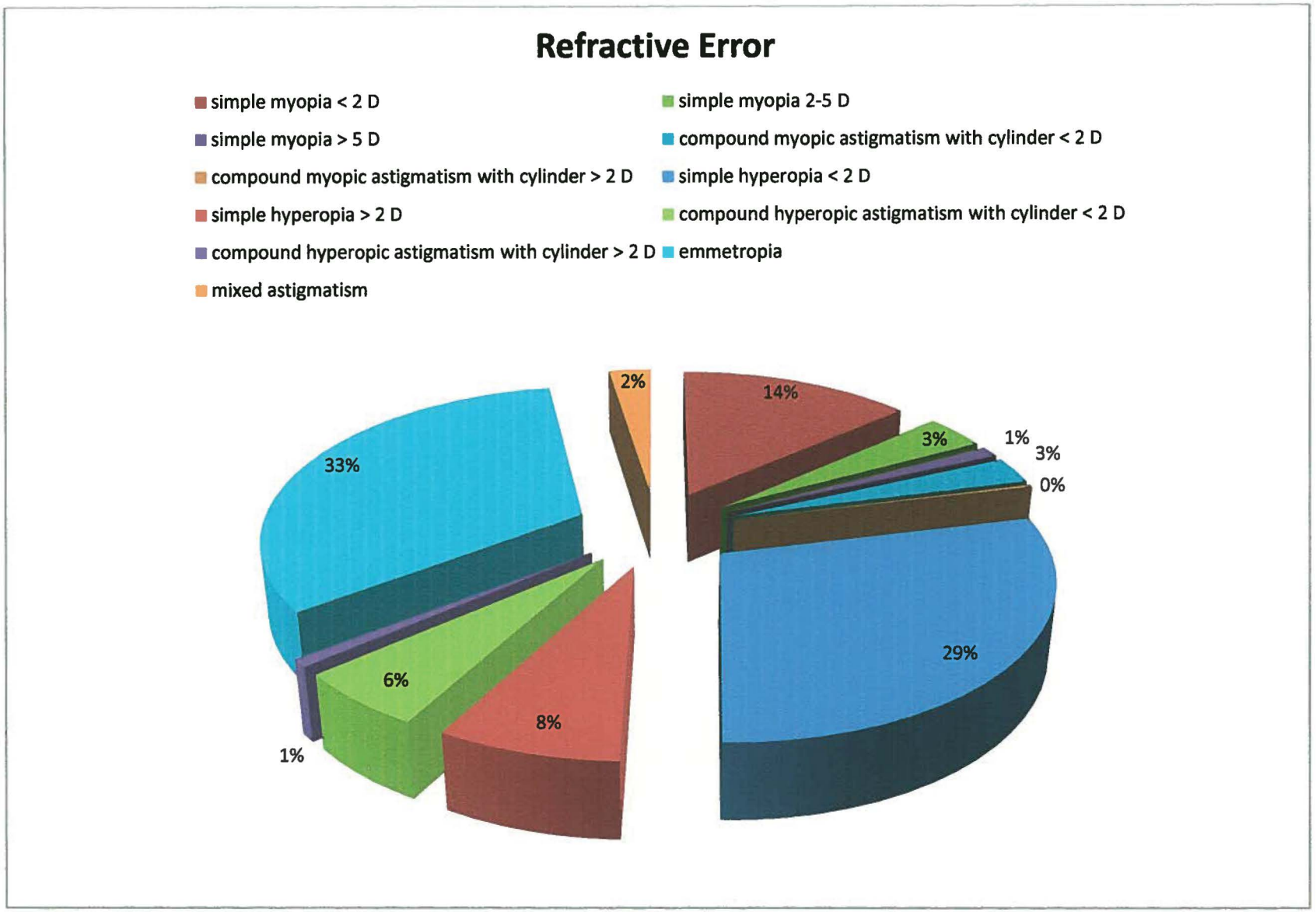


Table 5: Refractive errors in Sonora, Mexico and their respective percentage frequency.

Incidence of Blindness in the Population

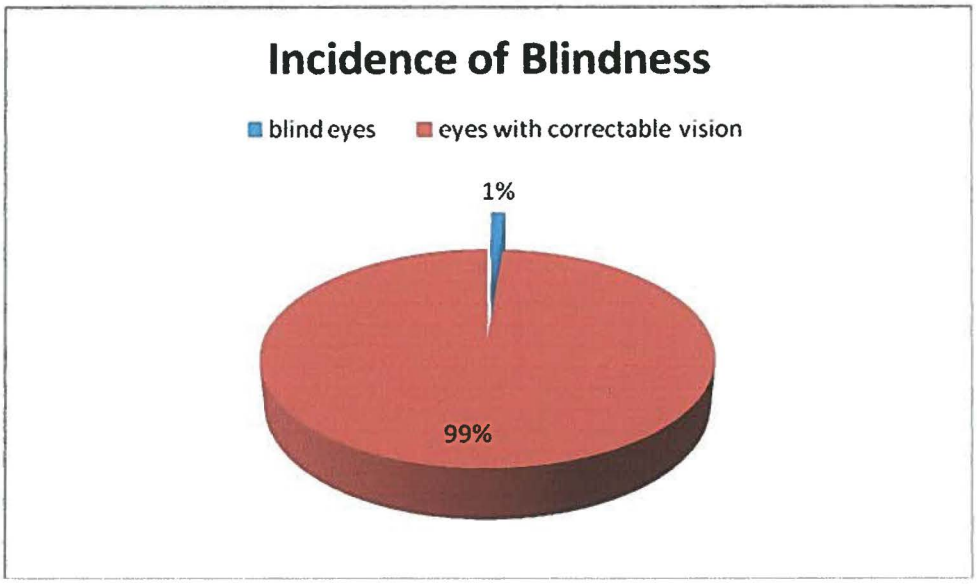


Table 6: Graph showing incidence of blindness within the population.

Percentage of the Population with Presbyopia

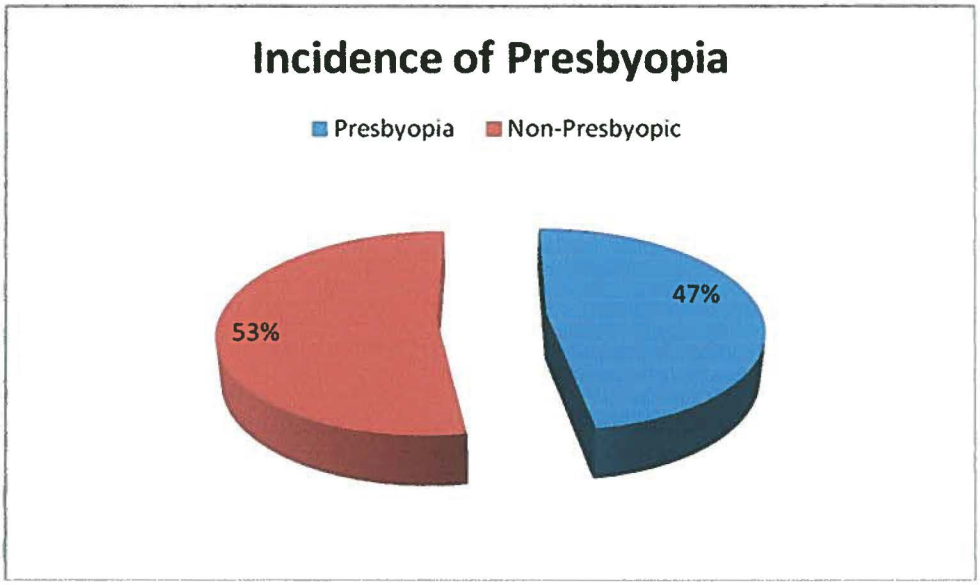


Table 7: Percentage of the population with presbyopia.

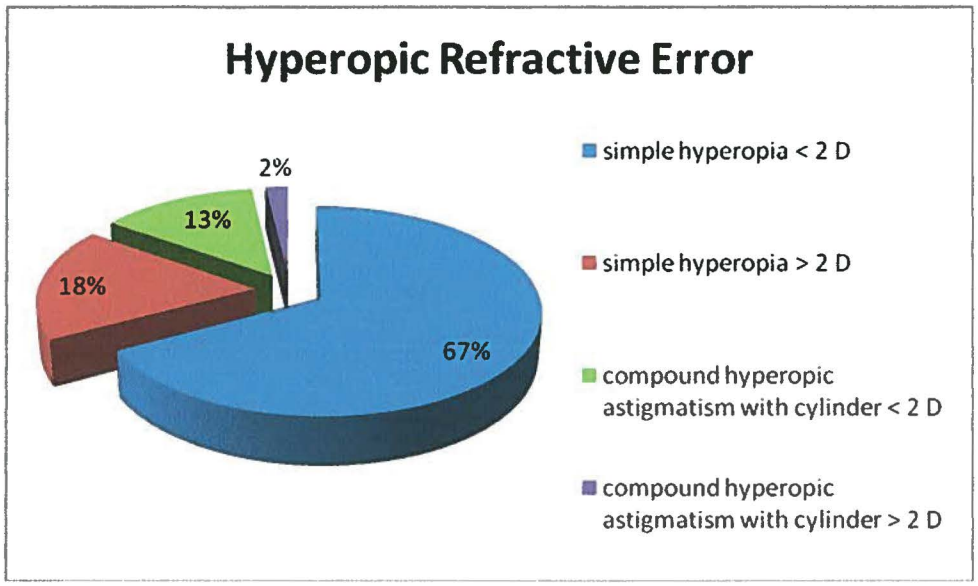


Table 8: Hyperopic Refractive Error

Myopic Refractive Error

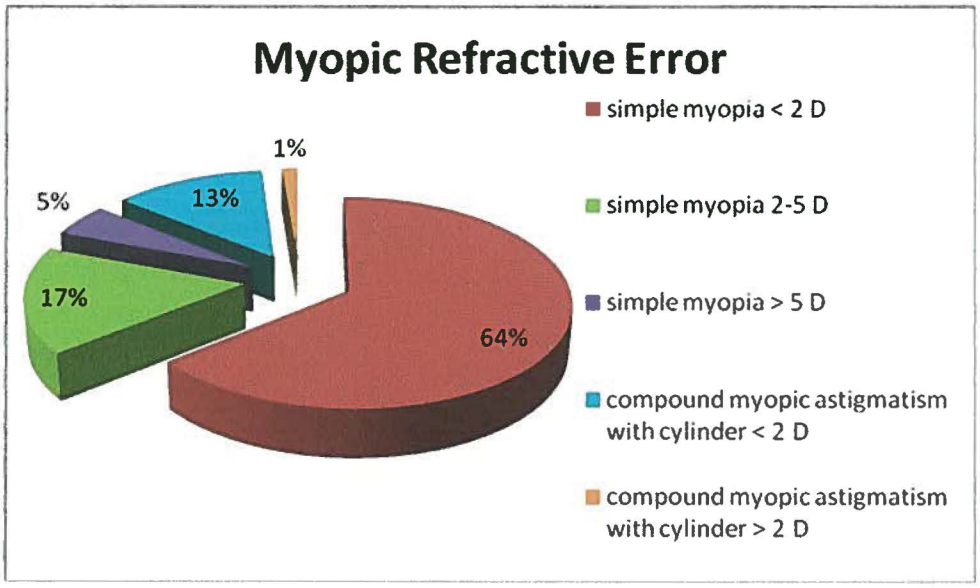


Table 9: Myopic Refractive Error

Types of Astigmatism Encountered

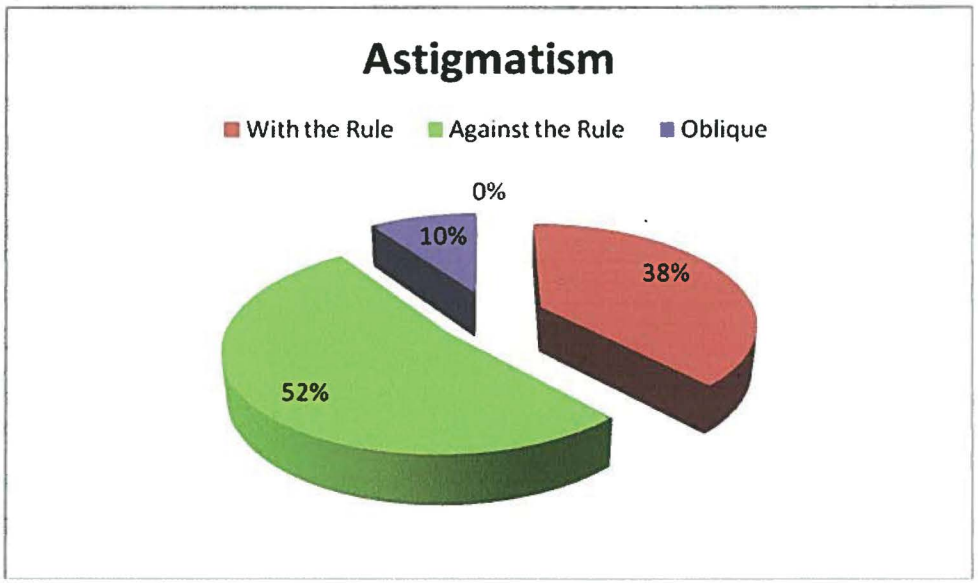


Table 10: Analysis of Astigmatic Error

Type of Bifocal Required

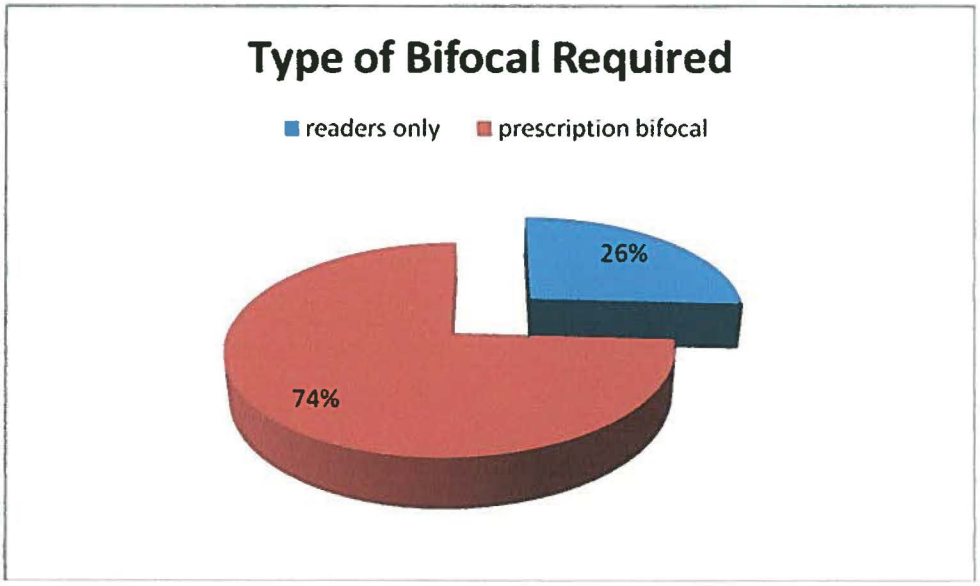


Table 11: Presbyopic patients needing reading only versus prescription bifocal correction

Patients Receiving Sunglasses

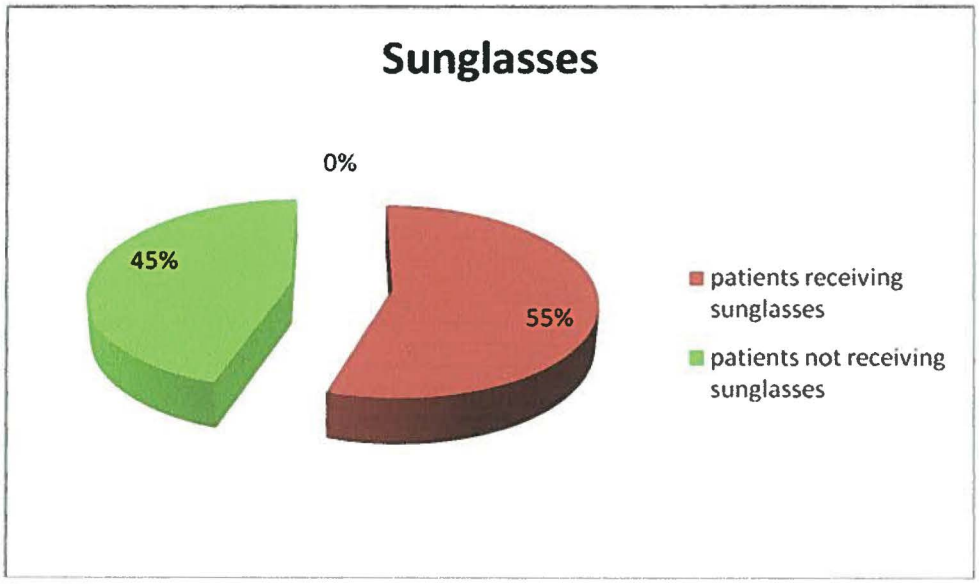


Table 12: Patients receiving sunglasses

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