AN EPIDEMIOLOGICAL STUDY

OF

REFRACTIVE ERRORS

AND

VARIOUS OCULAR ANOMOLIES

IN

DOMINICA, WEST INDIES

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MARCH 1998

ABSTRACT

In a sample population of the inhabitants of Dominica, West Indies, a greater prevalence of hyperopia over myopia was found in all age groups, and in both genders. Males were more likely to be myopic than females, with the highest incidence occurring in the 20 to 39 year-old age range. Astigmatic errors were found in 36% of the population, with the most frequently found error being -0.50D (average of -0.88D overall) with an "against-the-rule" orientation. The majority of those above the age of 40 were considered to be in need of a presbyopic prescription. Most refractive errors in a pediatric population were in the +0.25 to less than +2.00D range (86.6% of these showing less than 1.00D of hyperopia). An estimated 31.8% of the children seen were believed to received benefit from eyeglasses. The importance of vision screenings in pediatric populations is realized when considering the importance of vision in learning.

A positive linear correlation with an increase in age (of those over 40) was found in the incidence of pterygia and dense cataract formation. Of the total number of referrals made to the local ophthalmologist, 48.7% were for cataract removal surgery. In the age group of 40 years old and up, 1.6% indicated they were being treated for glaucoma. A higher incidence of glaucoma may have been expected when considering the estimated incidence found in other black populations. An increase in the awareness of glaucoma and screening procedures may aid in detecting others with this blinding disease.

It is hoped that the information contained in this study will be useful in caring for the people of Dominica,and that less people will suffer from undetected ocular conditions and/or anomalies.

PURPOSE:

The purpose of this paper is to present the prevalence of various eye conditions within the population of a Caribbean island, The Commonwealth of Dominica, West Indies. Its overall goal is to aid in supplying information that may be used by eye care professionals and others in better meeting the visual needs of this population.

The main topic addressed in this paper is the distribution of various refractive errors in a sample population. Included will also be discussions on the prevalence of various other ocular anomalies found in this sample population during a one-week volunteer mission. From the findings in this study various theories and hypotheses will be explored. Where appropriate, the findings of this study will be compared and contrasted with those of other studies.

METHODS:

The sample population used for this cross-sectional/prevalence study was obtained during a one-week volunteer eye care expedition, which took place from January 26, 1997 to February 2, 1997. This non-profit, charitable organization, known as Voluntary Optometric Services to Humanity (VOSH), consisted of volunteers who work together to help meet the visual needs of under-served people in America and abroad. These missions include various eye care professionals such as optometrists, opticians, optometric students, and non-optometric people who volunteer their time and services.

The volunteer group in this study was from the Michigan chapter of VOSH and consisted of 18 volunteers, which included 5 optometrist, 5 optometry students, and 2 opticians. During the one-week expedition all four major regions of the island were covered, including the cities of Portsmouth, Marigot, Grand Bay, and Roseau. At each site, 200 - 300 people were examined. The eye examinations included taking a brief history and chief complaint, monocular distance and near visual acuities, external health assessment, retinoscopy findings utilizing skiascopic lens rack sets (also known as "ret bars"), and an internal ocular health assessment (only those with a high suspicion of pathology were dilated).

Patient information was written on exam forms from which the data for this study was obtained. Data gathered also included the patients age, occupation, and gender.

CROSS-SECTIONAL/PREVALENCE METHOD:

One advantage of this type of cross-sectional/prevalence study is that it can be done in a relatively short amount of time using a sample from a population. One of its

purposes is to state the prevalence of certain conditions so that better planning methods of caring for the health of the population can be accomplished, such as the types of facilities and services to provide. It can also be used to help determine high-risk groups for various conditions and how to better screen for these conditions. A study such as this can also point out possible risk factors for various conditions, however, it cannot effectively determine cause and effect, but can be used to generate hypotheses.

A disadvantage of this study method is that it does not quantify risk, therefore it has limited use in predicting future health. It also has limited use in epidemic conditions, since the study samples are taken during a short time frame, which would most likely miss epidemic conditions.

LIMITATIONS:

As in any study there are limitations, some of which will be pointed out throughout this paper. The selection process of the sample population could be considered one limitation. A random selection was not made in selecting those patients to have examinations; the local nurses distributed a preset number of tickets to those they felt were in need of eye care. This introduces some bias into the selection process, as does the fact that the majority of those seen had some form of visual/ocular complaint, therefore those with no complaints and possibly no optical complications were not as likely to seek eye care from the VOSH team. With this in mind, it would be more accurate to consider this sample to be of the Dominican population with visual/ocular complaints rather than a simple random sampling of the general population.

GENERAL INFORMATION ON DOMINICA:

Dominica (not to be confused with the Dominican Republic) is a member of the West Indies Islands. It is approximately 29 miles (47 km) long and has an area of some 290 square miles (751 square km). Located approximately 15.5 degrees North latitude and 61.5 West longitude, it is bordered on the east by the Atlantic Ocean and on the west by the Caribbean Sea. The island is volcanic in origin with a tropical climate and mountainous terrain, with temperatures averaging around 80 degrees F (26.7 degrees C).[1]

Dominica is home to approximately 73,000 people with over 90% of them being descendants of African slaves which were brought to the island during the 18th century. A reservation in the northeastern region of the island is home to the descendents of the original inhabitants of the island, the Carib Indians.[1]

The fertile soil of Dominica's mountainous terrain gives nourishment to their principal economic activity of farming, with the chief export being bananas and other agricultural products. There are various manufacturing industries on the island such as fruit juice and alcoholic beverage distributors, a Coca-Cola and a Colgate plant.[1]

The history of Dominica includes wars between the French and the British who fought for control of the island. Dominica obtained its independence from Britain and became a self-governing nation in 1978, and was given the formal name of The Commonwealth of Dominica.[1]

Since its independence Dominicans have had many hardships and struggles, including how to meet the health care needs of their growing population. Several strides have been made, particularly since the devastating effects of Hurricane David (1979), in improving and expanding its primary health care services.[2] There are several district

clinics set up around the island to meet the basic needs of the population, and a main hospital near the capital city of Roseau. Eye care services are currently provided by the one ophthalmologist on the island and one private practice optometrist. The VOSH eye care volunteer team (and other volunteer groups) has also assisted in meeting the visual needs of the Dominican population by providing basic eye examinations and dispensing "recycled" (previously used) eyeglass spectacles.

DISTRIBUTION OF REFRACTIVE ERRORS

DIAGNOSTIC CRITERION:

In this subsection the prevalence of various refractive errors found in the sample population will be discussed. The data was obtained from the exam sheets of the patients that were seen in the one-week 1997 VOSH mission. The refractive errors were broken down into groupings of similar values (see the dioptric groupings in table 1). For the purpose of this study emmetropia was given a value of 0.00D (diopters) $\pm$ 0.25D. The placement of the refractive error for each patient was determined by taking the average of the retinoscopy spherical equivalents for the two eyes.

The reason for utilizing the written retinoscopy findings, rather than the final spectacle prescription, was that many of the spectacles prescribed were influenced by the availability of various spectacles at the time. To simplify a prescription, spherical equivalents were sometimes written, and balance lenses may have been written in cases of larger amounts of anisometropia. Also, as the availability of lower powered hyperopic multifocal eyeglasses began to diminish, reading-only spectacles were prescribed. To

bypass these "distortions" in refractive errors, retinoscopy findings were made use of, believing them to more accurately reflect the patient's true refractive error.

LIMITATIONS:

Beyond those already addressed, other possible areas of limitations of this study lie in the data collecting itself. Retinoscopy was sometimes performed in areas with little lighting control therefore reflexes were sometimes difficult to assess. Due to the presence of lens opacities in the elderly population and tendency of their pupils to be miotic (only a small percentage were dilated), accurate retinoscopy results were sometimes difficult to obtain in this group of the sample population. Also, it was rare for children and/or teenagers to be cyclopleged, therefore, it could be expected that there were actually more hyperopic refractive errors than were noted for this age range. Finally, the "ret-bars" which were used generally progress in 1.00 D steps, with the option to use an additional +/- 0.50 D sliding lens, therefore, these "refractions" were often rounded up or down to the nearest 0.50 D step.

REASONS FOR EXCLUSION OF DATA:

Data was excluded from this portion of the study for various reasons. Two reasons for dismissal of data included failure to document the gender and/or age of the patient, and/or failure to record the retinoscopy findings. Another reason for exclusion was in large amounts of anisometropia, which caused the spherical equivalents of the two

eye powers to be greater than 3.00 D apart (few fell in this range, making it easier to simply exclude them for the population study).

RESULTS:

Out of the 1,155 available patient examination forms available from this sample study, 1,005 were found to meet the necessary criterion to be included in this section of the study (87% of the sample population). For each patient in the sample their average refractive error was placed in various ranges of dioptric power. The data was then further broken down into age and gender groupings.

Table 1 demonstrates the prevalence of each age grouping in this sample; a breakdown of the percentage of each gender is also included.

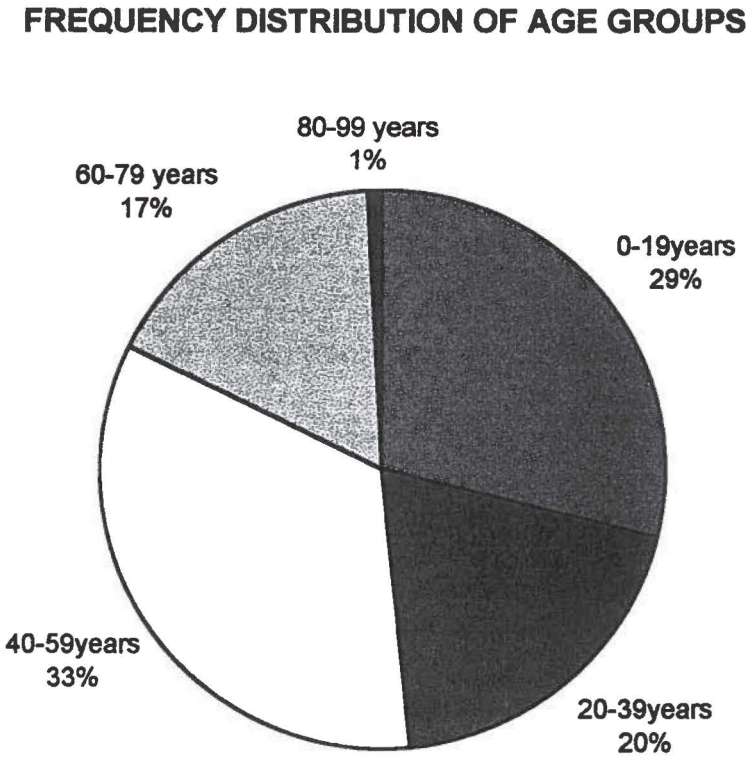
TABLE 1:

FREQUENCY DISTRIBUTION OF AGE GROUPS

AGE (YEARS)	# IN SAMPLE	RATE (%)	%MALE / %FEMALE (RATIO)	
0-19	289	28.8	36.0 / 64.0	(1: 1.8)
20-39	197	19.6	15.7/ 84.3	(1: 5.4)
40-59	340	33.8	23.2/ 76.8	(1: 3.3)
60-79	171	17.0	26.7/ 73.3	(1: 2.7)
80-99	8	0.8	25.0/ 75.0	(1: 3.0)
TOTALS:	1005	100.0	26.1/ 73.9	(1: 2.8)

* See FIGURE 1 for a pie chart visualizing the frequency of the various age distributions in the sample.

FIGURE 1:



The average, or mean, age of this sample was 25.8 years old. The most frequently seen age range (mode) was 40-59 years. As demonstrated in Table 1, 33.8% of the patients fell into this category. Females made up 73.9% of the 1005-person sample population, and 26.9% were male. Below is another breakdown of the population percentages by age and gender, listed in order of highest to lowest frequency.

TABLE 2:

FREQUENCY OF AGES BY GENDER

MOST	AGE	GENDER	RATE (%OF TOTAL)
FREQUENT	40-59	FEMALE	26.0
↓	0-19	FEMALE	18.4
	20-39	FEMALE	16.5
	60-79	FEMALE	12.5
	0-19	MALE	10.3
	40-59	MALE	7.9
	60-79	MALE	4.5
	2 0-39	MALE	3.1
LEAST	80-99	FEMALE	0.6
FREQUENT	80-99	MALE	0.2

Table 3 shows a breakdown of the frequencies of the various refractive error groupings (classified into groups by the method previously stated).

TABLE 3:

FREQUENCY DISTRIBUTION OF REFRACTIVE ERRORS

REFRACTIVE ERRORS (X in diopters)		# IN SAMPLE	RATE (% OF TOTAL)	MYOPIA/ EMMETROPIA/ HYPEROPIA
	$-8.00 < X \leq -6.00$	4	0.4	
MYOPIA:	$-6.00 < X \leq -4.00$	18	1.8	21.5% MYOPIA
	$-4.00 < X \leq -2.00$	43	4.3	
	$-2.00 < X < -0.50$	151	15.0	
EMMETROPIA:	$-0.25 \leq X \leq +0.25$	204	20.3	20.3 % EMMETROPIA
	$+0.50 \leq X < +2.00$	516	51.3	
	$+2.00 \leq X < +4.00$	66	6.6	
HYPEROPIA:	$+4.00 \leq X < +6.00$	2	0.2	58.2% HYPEROPIA
	$+6.00 < X < +8.00$	1	0.1	
TOTALS:		1005	100	100.0%

As shown in table 3, the most prevalent refractive error in the sample population was in the low hyperopic range (+0.50 D to less than +2.00 D), that made up 51.3% of the total population. For the sake of simplicity, all refractive errors falling outside of the above ranges were excluded; their frequency was less than 1% of the total. For a pie chart graph summary of the above results see FIGURE 2

FIGURE 2:

Frequency Distribution of Refractive Errors

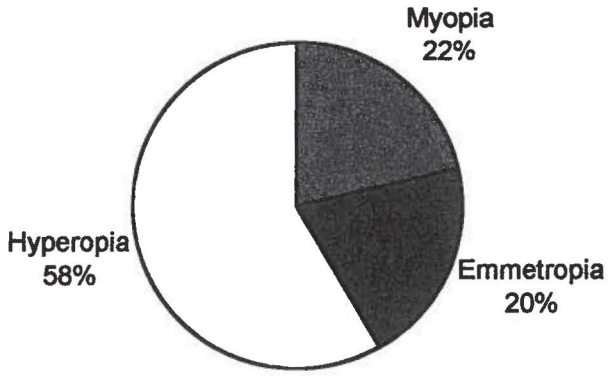


TABLE 4:

FREQUENCY DISTRIBUTION OF REFRACTIVE ERRORS BY GENDER

	MYOPE	HYPEROPE	EMMETROPE	TOTAL
MALE	62 (0.6)	150 (14.9)	50 (5.0)	262 (26.1)
FEMALE	154 (15.3)	435 (43.3)	154 (15.3)	743 (73.9)
TOTAL	216 (21.5)	585 (58.2)	203 (20.2)	1005 (100.0)

(Numbers in parentheses are percentages of the total sample population)

Table 4 shows the frequency distribution of each type of refractive error and gender. The most frequently seen patient was the female hyperope, making up 43.3% of the population. The second and third most commonly found patients were the myopic and emmetropic females, both making up 15.3% of the population each. Finally, the most common male refractive error in the study was hyperopia at 14.9%, followed by emmetropia at 5.0%, and the least frequently seen refractive error was the male myope (0.6%).

Table 5 demonstrates the percentages of each gender falling into each of the three basic types of refractive errors. These percentages are adjusted for the differing amount of male versus female patients in this sample population.

TABLE 5:

A BREAKDOWN OF VARIOUS REFRACTIVE ERRORS PER GENDER

	MYOPIA	HYPEROPIA	EMMETROPIA	TOTAL
MALE :	23.7%	57.3%	19.1%	100.0%
FEMALE :	20.7%	58.5%	20.7%	100.0%

Table 5 is useful in demonstrating that in this study both males and females are more likely to be hyperopic than myopic (a 1: 2.4 ratio for males, 1: 2.8 for females) however, males are 14.5% more likely to be myopic than females. Conversely, females are 2.1% more likely to be hyperopic in comparison to males.

These results agree with those of a study done in 1988 by Dr. Alfred Dib, who was a private practice optometrist in Dominica.[3] In his study of the refractive errors of 779 of his patients, he found males to be more likely to be myopic than females by approximately 20.7%. His data also showed the females in his sample to have an 18.2% higher tendency towards hyperopia over males. He also found males to have a higher tendency to be myopic over hyperopic, this being in contradiction to the results of this study in which BOTH males and females were shown to have a greater tendency to be hyperopic over myopic.

Dr Dib's study showed a prevalence of 53.6% myopia (with 39.5% hyperopia) in males and a 44.4% myopic occurrence (46.7% hyperopia) in females. What is the reason

behind the increased prevalence of myopia found in Dr. Dib's study versus that demonstrated in this study?

It can be theorized that the average laborer (or lower income population) would be less likely to seek services from a private practice optometrist due to the cost of eye examinations and spectacle corrections. Therefore it can be stated that Dr. Dib's population probably consisted of those people with higher than average incomes, and more than likely, a higher educational background than the general Dominican population. Due to the fact that the exams provided by the VOSH team were provided free of charge, with only a minimal fee on the eyeglasses, it could be assumed that there was a greater percentage of the average/lower income population of the island seeking assistance from this team. Based on these assumptions a hypothesis could be made that would help to support the theory that those with higher educational levels are more likely to become myopic.

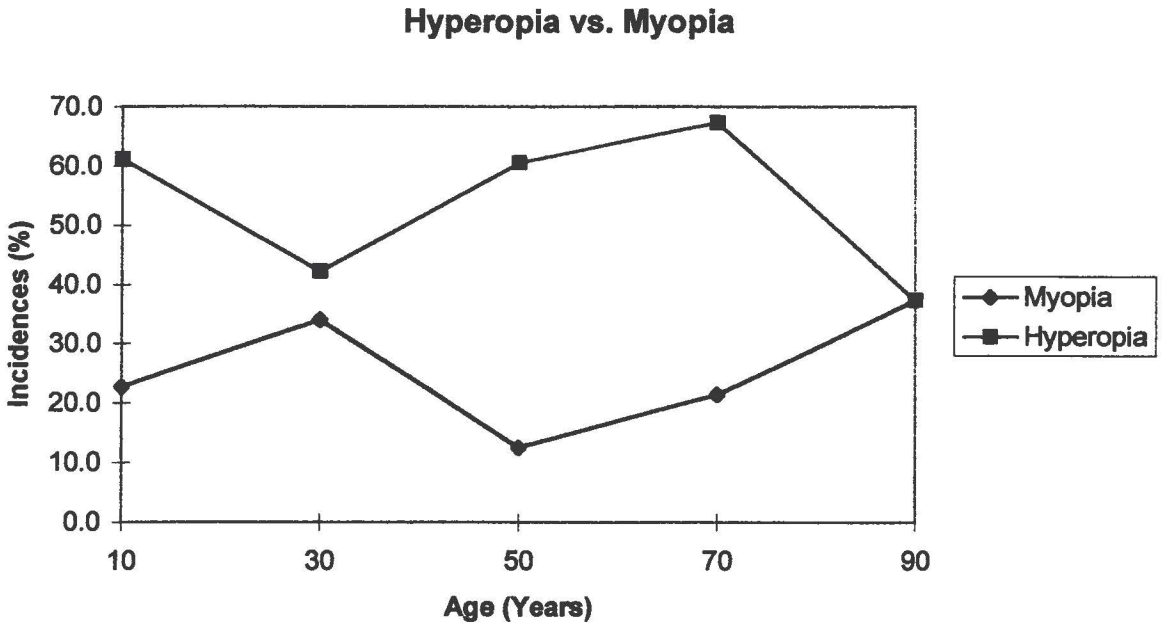
The finding of an increased prevalence of hyperopia over myopia has been reflected in other studies of developing country populations. A study of refractive error distributions found by VOSH teams in a Honduran population showed a +0.50D average[4], and +0.75D was the average value found on a mission to Nicaragua.[5] A higher frequency towards low hyperopic refractive errors was also found in rural Central and South America, and in natives in Fiji, South Pacific.[6, 7]

The prevalence of myopia in the entire sample population of Dominicans was 21.5% (58.2% prevalence of hyperopia). In comparison, a study done in 1983 on the

American population showed the prevalence of myopia to be 25%.[8] Various theories attempt to explain the reason for the variance between the average refractive errors in these countries compared to the more myopic refractive errors of the American population. Some possibilities are the influences of the environment, climate, education, and genetics. A study working with a community of Eskimos advanced the theory that environmental factors may play a large role in determining refractive errors. A positive correlation between an increased amount of myopia and the attendance of school by Eskimo children was found. Stating that an increased level of education, with a resultant elevated amount of near point stress, leads to an increase in "near-sightedness" or myopia.[9] Considering the overall increased education level of Americans compared with those in developing countries, this theory may explain the increased prevalence of myopia in Americans.

The frequency distribution of myopia vs. hyperopia in each age group is demonstrated in Figure 3. The peak incidence of myopia for both males and females (together and separate) occurs at ages 20-39 and again at 80-99. The increase in the frequency of myopia in the 80-99 range may be attributed to the tendency towards myopia with the increase of nuclear sclerotic changes in the crystalline lenses of the elderly population, of which most have not undergone cataract surgery. The myopic shift occurring in the 20-39 year-old range may again reflect the theory, stating a tendency of the eyes to become more myopic in those with higher levels of education. This may be supported by the fact that occupations requiring the most near point vision, and/or the highest educational level were more frequently found in this age population than any other.

FIGURE 3:



The results of Dr. Dib's study showed a relatively significant relationship between the distribution of occupations vs. refractive errors.[3] He found that there was a higher incidence of myopia in students and teachers and a higher incidence of hyperopia in those people with occupations requiring little near point demands on their visual system. Two schools of thought can attempt to explain this. One is that those with an increased near point demand have a tendency to become myopic (which has already been discussed). The second being that those with a tendency towards myopia are more apt to choose occupations requiring more near point work.[3]

Dr. Dib found the highest incidence of myopia to be at age 23 (vs. a peak incidence of 48 years of age for hyperopia). Some possible explanations for these results were stated in his paper. First was the possibility that an increased emphasis on

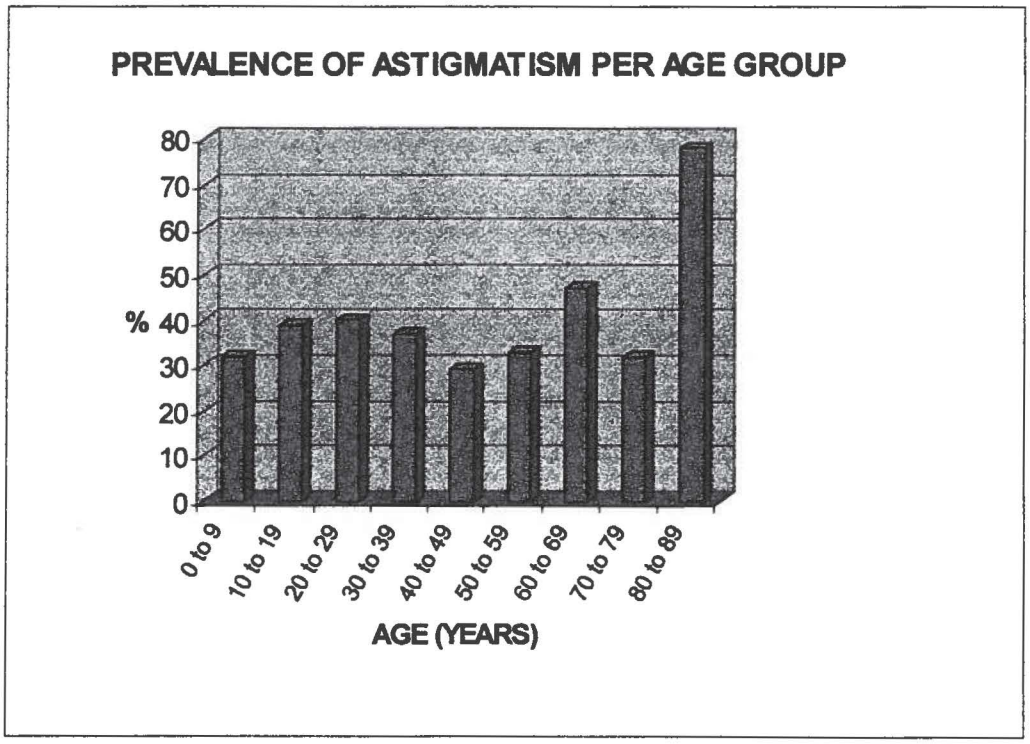
education in Dominica in the previous 25 years of the study may have resulted in a peak incidence of myopia at the age of 23. Another option was that hyperopes are less likely to seek eye care in their younger years due to their ability to compensate for their refractive error by the use of their ample accommodative system.

Either of these two theories may explain the increased incidence of myopia in the 23-year-olds of Dr. Dib's study, or the peak incidence occurring in the 20-39 year-old range in this study. Also keep in mind that this study sample was taken in 1997 versus Dr. Dib's which was conducted in 1989, an 8 year difference. If the higher incidence of myopia within these populations was a result of increased importance on education in the 25 years previous to Dr. Dib's study, then we could expect that peak age to have moved up by 8 years in this study, making it now around 31 years. The mean age of the 20-39 year-old range is 29.5 years old, however with so many variables this result in itself is limited in its ability to support or contradict this one particular theory. In comparison to the findings in a Honduran population during a similar VOSH team based study, the peak incidence of myopia found in the 21-30 year-old age range, was similar to results found in both studies of the Dominican population.[4]

To determine the prevalence of astigmatic errors vs. spherical and/or plano corrections data was again taken from the retinoscopy findings of each patients exam form. The dioptric values of both eyes were observed. If an astigmatic error was found in both eyes then the value from the right eye was used for this portion of the study. Astigmatic errors were found in 36% of the population in one or both eyes, with the

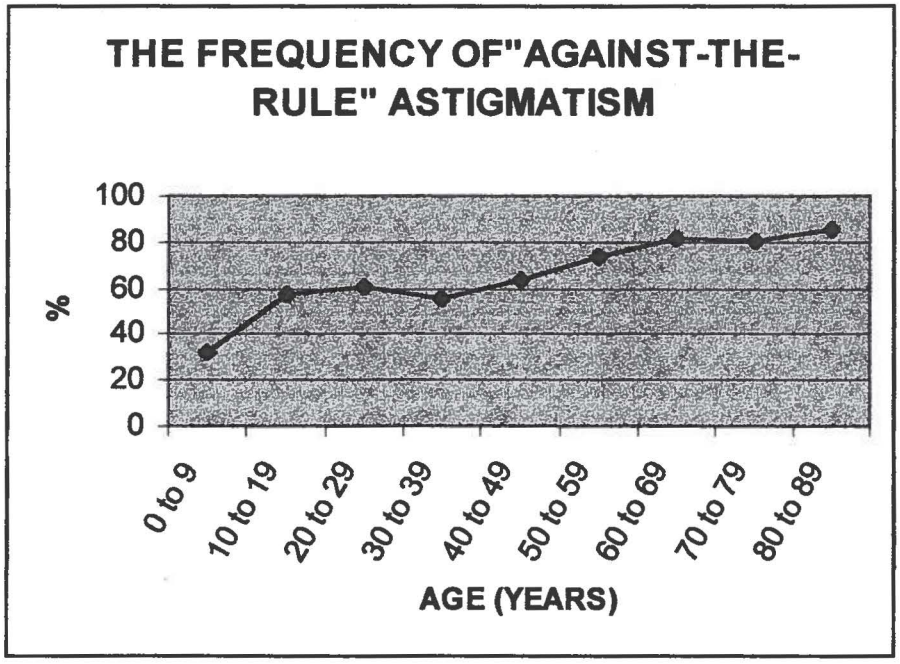
greatest frequency occurring in the 80-89 year-old age group. It should be noted once again, that an extremely small population sample fell in the 80-89 year range, therefore the results from this group had an increased potential of being skewed (see Figure 4 for a graph of the percentage of astigmatic errors per age grouping). The average astigmatic error for each age group ranged from -0.71D to -1.32D, with the overall average being -0.88D, and the most frequently found error (mode) being -0.50D.

FIGURE 4:



The majority of the astigmatic errors (58%) were in an "against-the-rule" orientation (axis $90^{\circ}\pm30^{\circ}$), and a 42% "with-the-rule" astigmatism (axis $180^{\circ}\pm30^{\circ}$). Figure 5 shows an apparent positive linear correlation between age and "against-the-rule" astigmatism.

FIGURE 5:



These results can be compared to those found in other populations. In Honduras astigmatism was found in 16.1% of right eyes, and 14.3% of left eyes with an average cylindrical error of -1.12D and -1.20D, respectively.[4] Similarly, it was found that people in Fiji showed low "against-the-rule" astigmatism in 21% of the right eyes examined in a sample population.[7]

A detailed summary of the onset of presbyopia cannot be determined from this study. However, it may be noted that approximately 98-99% of the population above the age of 40 was considered to need a bifocal or reading spectacles for near work. Due to the nature of these VOSH exams, detailed assessments of the required add powers were not always done. Rather, those patients over 40 years old were considered presbyopic and in need of a near point correction, which was prescribed mostly based on symptoms, distance refractive errors, near visual acuities and ages rather than by actual trial of the near point powers. In some cases presbyopic corrections were prescribed for those who may not have actually needed the additional assistance with near-point viewing. Due to the fact that these patients were likely to use these spectacles for several years, those on the verge of being considered a presbyope were given a multifocal correction so that it would be helpful to them into their "presbyopic years".

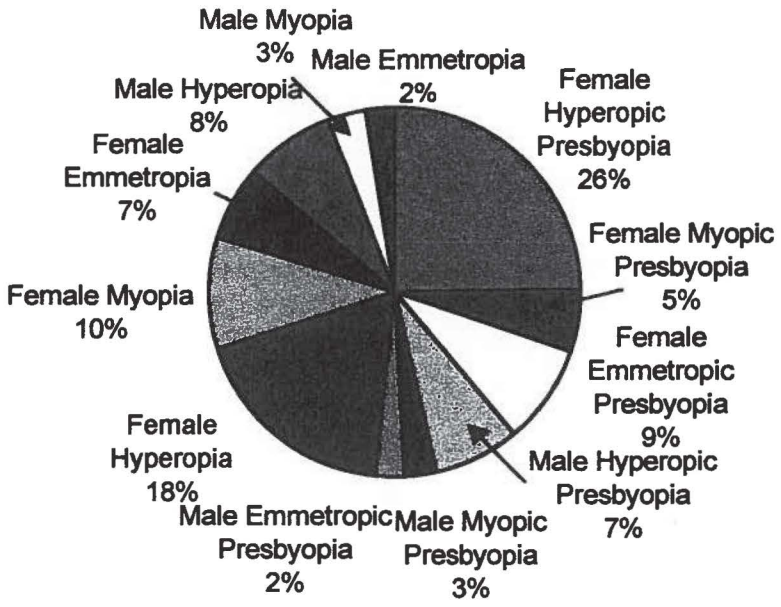
Some studies have found the onset of presbyopia to occur at an earlier age in some populations (as compared to that in the American population). Early presbyopia was found to occur in areas such as India, the Philippines, Bolivia and Somalia, where presbyopia was not unusual to find in patients as early as their late 20's or early 30's.[10] A theory that environmental influences, such as high temperatures and increased ultra-violet (UV) exposure may lead to an earlier onset of presbyopia, could pertain to the Dominican population.[10] With the high level of UV exposure in this tropical region, an apparent earlier onset of presbyopia in Dominica could be used to help support this theory.

Another factor to consider is that there is a higher incidence of hyperopia in the Dominican population as compared to the American population. Optically speaking, hyperopes in general tend to require presbyopic corrections sooner than those with myopic refractive errors.[11,12] A more detailed study on presbyopic corrections may give some insight into these theories.

Figure 6 is a pie chart demonstrating the prevalence of various refractive errors for all ages of the sample population broken down by several factors including myopic, hyperopic, and emmetropic distance refractive errors, non-presbyopic vs. presbyopic prescriptions, and male vs. female. The purpose of such a detailed breakdown of the various types of refractive errors is not only for overall epidemiological purposes, but this information can be utilized by those who bring over eyeglasses to be dispersed to the Dominican population (organizations such as the VOSH groups). By utilizing the percentages of each type of spectacle prescription demonstrated in this sample study, it is hoped that the most efficient supply of eye glasses can be brought to the island, therefore making the supply of eye spectacles match that of what is needed by the population. For volunteer organizations such as VOSH, this information can be useful in helping to determine where the needs are for the Dominican population. With that insight it is hoped that they can best prepare to meet those needs during their missions to Dominica, and also for other teams serving similar populations to that of Dominica.

FIGURE 6:

FREQUENCE OF VARIOUS REFRACTIVE ERRORS IN A SAMPLE POPULATION



REFRACTIVE ERRORS IN CHILDREN OF DOMINICA:

A separate section of this study is devoted to the 0-12 year old age group. Of the total population, 20.9% were in this age range. Of the 220 children that made up this pediatric sample population, 128, or 58.2% were female and 92 or 41.8% were male. Of this population group 20.0% were myopic, 61.8% hyperopic and 18.2% were considered to be emmetropic (0.00D $\pm$0.25D). Note, the majority of children's eye examinations were done without the use of cycloplegic drugs used to relax the accommodative system, therefore, there was more than likely a higher incidence of hyperopia than that which was indicated in this age group. The most frequently found refractive error for this pediatric population was in the +0.25D to less than +2.00D range. Of the 57.7% in this dioptric

power range 86.6% were +1.00D or less (spherical equivalent average between the two eyes). In the case of children, who generally have a large amount of accommodative amplitude, those with less than 1.00D of hyperopia generally do not require spectacles to correct this error. Exceptions to this rule take place in the cases of esophoria/esotropia in which the small hyperopic prescription may be beneficial to prescribe.

Table 6 shows the breakdown of the various refractive errors.

TABLE 6:

FREQUENCY DISTRIBUTION OF REFRACTIVE ERRORS OF A PEDIATRIC POPULATION

REFRACTIVE ERRORS(X IN DIOPTERS)		# IN SAMPLE	RATE (% OF TOTAL)	MYOPIA/ EMMETROPIA/ HYPEROPIA
	$X < -4.00$	3	1.4	
MYOPIA:	$-4.00 \leq X < -2.00$	3	1.4	20.0% MYOPIA
	$-2.00 \leq X \leq -0.50$	38	17.3	
EMMETROPIA:	$-0.25 \leq X \leq +0.25$	40	18.2	18.2 % EMMETROPIA
	$+0.50 \leq X \leq +2.00$	127	57.7	
HYPEROPIA:	$+2.00 < X \leq +4.00$	9	4.0	61.8% HYPEROPIA
	$+4.00 < X$	0	0.0	
TOTALS:		220	100.0	100.0%

Of the children seen 68.2% demonstrated refractive errors of –0.25D to +1.00D. Under most conditions those in this power range do not require spectacles, therefore, it could be estimated that of the pediatric population in this sample approximately 31.8%

had the potential of benefiting from the use of eyeglasses. This study of the children of Dominica was to serve two specific purposes. One purpose was to assist those people who dispense eyeglasses to children (such as the VOSH group). The stated results could be used to select an appropriate collection of children's eyeglasses to best match up with the refractive errors of this population.

Second, these results could be considered when evaluating the importance of visual screenings of these children, and how to best conduct these screenings. Although this age group has a lower incidence of non-emmetropic refractive errors in comparison to the other age groups, detection of those with valid ocular problems is important during these early developmental stages of their lives. It has been noted in the past that visual screenings in Dominica were conducted by only taking distance visual acuities. This method alone can be considered insufficient when considering that nearly one-half of all children with visual problems that interfere with their educability and their health status go undetected by Snellen testing alone and are unknown to the children, their parents, or their teachers.[13]

Several attempts at developing an effective screening method have been explored, one of the most well known being that which evolved from the Orinda Study which was conducted in 1959. This study led to the development of a vision screening method known as the Modified Clinical Technique (MCT) which has been useful in setting standards for vision screenings in America for over 35 years. This MCT screening consists of a far and near visual acuity, retinoscopy, cover test, and ophthalmoscopy.

Ideally this screening would take place before the child attempts to learn to read, and then be followed with a Snellen visual acuity each year after.[13]

It has been found that the most reliable results occur when eye care professionals conduct the screenings. Due to time restraints and a limited number of eye professionals in Dominica, this would be difficult. However, an optometrist who trained graduate school health nurses to perform the MCT has dealt with this problem successfully in the past.[13]

Other methods of screenings can be explored which would take less technical training than that required by the MCT. Because of the greater number of hyperopes than myopes in this age group, a distance visual acuity alone will most often miss the low hyperopic patients. To better detect these refractive errors near visual acuities should be taken. Another method for detecting latent hyperopes (with a greater than +1.50D error) is by employing the "+ lens test". When a child can demonstrate the same visual acuity at distance (20 feet) while viewing the chart through +1.50D lenses then a latent hyperopia of 1.50D or greater is suspected, and this child should be referred for a more complete eye examination.

Another factor that can be useful in vision screenings is the determination of the child's phoric/tropic position. One of the easiest ways to screen for those with tropias/strabismus (or amblyopia, etc.) is by employing stereopsis testing. Stereopsis tests take very little training to administer and are relatively easy for children to understand. If a child demonstrates good stereopsis then there is less concern of abnormal phorias/tropias or amblyopia.[14] Therefore, stereopsis tests such as wirt rings and the random-dot butterfly test may prove to be a good investment for the screening

purposes of children. For those children that do not demonstrate a normal amount of stereopsis, tropias can be looked for by the unilateral cover/uncover test (this method would need to be taught to those conducting the screening). Another method of detecting a strabismus (tropia/ eye turn) is by use of red/green glasses and a Worth 4-dot tested at both distance and near. This would take less training on the part of the screeners although they would need to know what the various answers represent.

With further studies of this young population as to the various ocular problems that are most likely to affect them, it is hoped that more appropriate visual screening processes can be performed on the children of Dominica. By evaluating the effectiveness of the vision screening methods that are employed, modifications to the screening procedures and/or referral criteria can be done to make the screenings more efficient to better detect those with ocular difficulties or abnormalities. When considering the importance of vision in learning, early detection and treatment of visual problems in children during their educational years should be a public health goal.

OCCURRENCE OF OCULAR ANOMALIES

PTERYGIUMS:

A brief section of this study is dedicated to pointing out the various ocular anomalies detected on this VOSH mission. The first anomaly to discuss is the prevalence of pterygium formation on one or both eyes in the Dominican population. VOSH doctors were asked to document any findings of pterygiums on the patient's exam forms. This data was used to formulate the following table demonstrating the prevalence per age group.

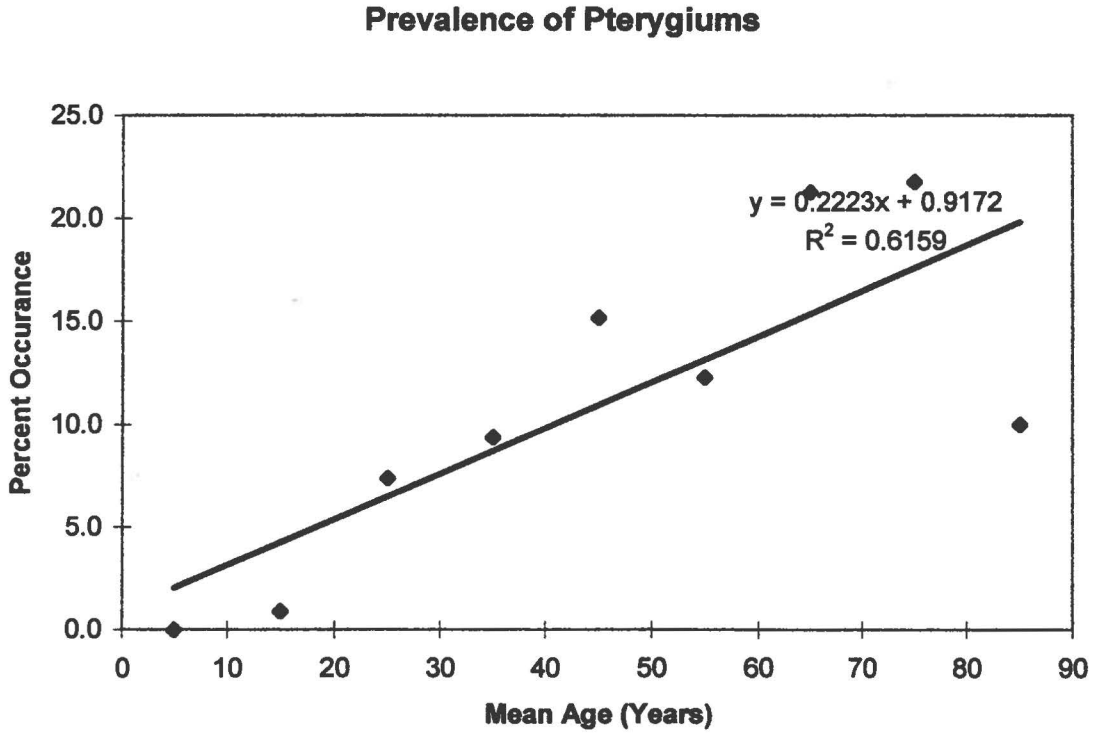
TABLE 7:

PREVALENCE OF PTERYGIUMS PER AGE GROUP

AGE (years)	PREVALENCE OF PTERYGIUMS	# IN SAMPLE	OCCURANCE
0-9	0	91	0.0%
10-19	2	216	0.9%
20-29	6	81	7.4%
30-39	13	139	9.4%
40-49	30	197	15.2%
50-59	20	162	12.3%
60-69	26	122	21.3%
70-79	12	55	21.8%
80-89	1	10	10.0%
TOTAL:	108	1073	10.1%

- For a graphical representation of the above results see Figure 7.

FIGURE 7:



The overall prevalence of pterygia found in this population was 10.1%. Similar results were noted in Central and South Americans where pterygia were found in 11.9% of all patients examined in a study.[6] Factors believed to contribute to the formation of pterygia are increasing age, and an increased exposure to ultraviolet (UV) light.[15] To support the linking of increased sunlight exposure to pterygium formation it has been noted that its prevalence rises nearer the equator, and its more common in coastal areas subject to bright sunshine than in inland areas.[15]

Age is believed to have a positive correlation with pterygium formation due to the accumulation of radiation damage over many years.[15] The data taken in this sample appears to support this theory in that there appears to be an increase in the prevalence of pterygium formation as the population age of Dominicans increases. Exceptions to this trend were seen in the 50-59 year-old range, and again in the 80-90 year-old range in which there was only a small number of patients to obtain data from (which may misrepresent the true prevalence of the general population in this age range). This population does have a high exposure to sunlight due to their close proximity to the equator. Although this study does not prove any positive correlation between a higher incidence of ultraviolet light exposure and pterygium formation, it does suggest this.

Of the total number of referrals made to the local ophthalmologist 17.9% were for pterygium removals. Pterygiums have a tendency to become inflamed, especially in the elderly population that tends to have increased signs and symptoms of dry/irritated eyes.[16] They also may induce astigmatic refractive errors by their pulling action on the cornea, therefore distorting vision, and they sometimes grow to the extent of covering the

visual axis. Although removal surgeries can be done, many of them will re-grow. Therefore, decreasing the initial formation of these growths may be the most effective way to combat this ocular anomaly. By educating Dominicans on how to protect their eyes from the sun's harmful UV rays the chance of pterygium formation can be reduced. It has been shown that ambient UV rays can be reduced by up to 50% by wearing a brimmed hat, while plastic sun lenses will generally block between 90-100% of the radiation.[17]

DENSE CATARACT FORMATION:

Another ocular condition believed to have a positive correlation to increasing age and UV exposure is that of cataract formation.[15] In a study on cataract formation and latitude, it has been stated that the strongest predictor of the future need for cataract surgery for a person is their latitude of residence. This study correlates latitude directly with the UV-B content of sunlight, suggesting that the probability of cataract surgery increase by 3% for each 1° decrease in latitude.[18]

An accurate assessment was unobtainable in this study due to the fact that most of the patients were not dilated, and there was no slit lamp for accurate grading of lens opacification. However, of the total number of referrals made for various ocular anomalies 48.7% of them were made for cataract removal, due to severely dense cataracts.

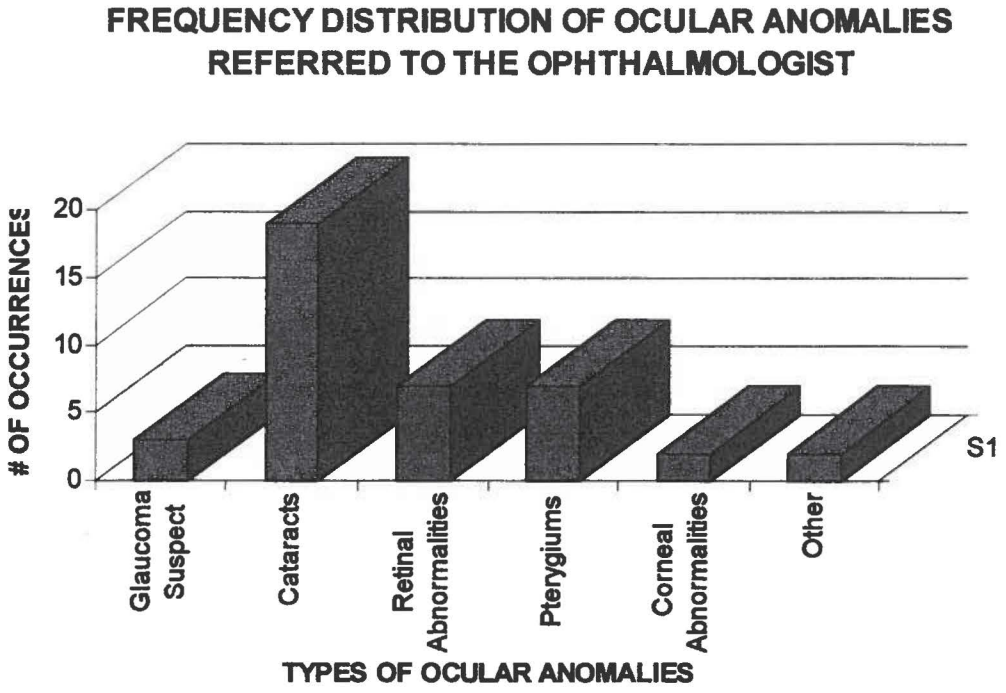
Based on data in this study, information on the prevalence of severely dense cataracts in the geriatric population of this study can be stated as follows: 1 in 20 patients ages 60-69 years presented with severely dense cataracts; 1 in 7 patients ages 70-79 years presented with severely dense cataracts; 1 in 2 patients ages 80-89 years presented with

severely dense cataracts. Note that some of this geriatric population had already undergone cataract surgery, therefore the prevalence of dense cataracts may be underestimated in this sample. A more detailed study on the cataract formation in the Dominican population may be beneficial.

REFERRALS MADE FOR OTHER OCULAR ANOMALIES:

Figure 8 shows a breakdown of the various types of anomalies that were referred to the local ophthalmologist for further evaluation and/or treatment. Included in this are those anomalies already stated plus other anomalies/pathologies. There were a total of 39 referrals made which represents approximately 3.4% of the total population sample.

FIGURE 8:



The percentage of the population presented as "glaucoma suspects" does not include those patients who were previously diagnosed as having glaucoma. It represents those patients in which a high suspicion of glaucoma was present due to one or more of the following factors: abnormally high intraocular pressures (pressures were not taken routinely, only on those where glaucoma was suspected); abnormally large cup/disc ratios, an asymmetry between the cup to disc ratios between the two eyes, or other suspicious optic nerve findings such as vertical elongation of the "cups" and/or obvious notching. Due to difficulty in detecting glaucoma patients in their earlier stages of the disease by the methods employed by the VOSH team, it can be expected that there was a greater number of glaucoma suspects than was detected.

The number of patients who stated they were currently being treated for glaucoma was 19. This number makes up 0.8% of the total population and 1.6% of the population over the age of 40. Some studies have shown people of an African origin or descent have a higher likelihood of developing glaucoma. According to the Baltimore Eye Survey, the prevalence of primary open-angle glaucoma in persons over age 40 is 1.7% for Caucasians, and 5.6% for African descendants (living in America).[19] Considering greater than 90% of Dominicans are black, we may have expected a higher prevalence of glaucoma than that which

was found. More detailed studies on the glaucoma prevalence in the Dominican population may aid in supporting or contradicting this concept. Further studies may demonstrate those groups of people who appear to be at higher risk of having glaucoma, and various methods as to how to best screen for those affected by this disease can be explored.

Retinal and corneal abnormalities in combination with two other referrals (simply classified as "other") make up the remainder of the total amount of referrals made to the ophthalmologist during this VOSH trip. The most common retinal abnormalities noted were considered to be a result of diabetic changes in the retinal vasculature known as diabetic retinopathy. Once again, it should be stated that the procedures followed in the VOSH examinations did not include dilated fundus examinations unless a pathological process was suspected of occurring. It can be assumed that cases of diabetic retinopathy were not always detected, therefore an accurate study of the prevalence of diabetic retinopathy can not be concluded from this study.

SUMMARY

The results of information gathered of a sample population of the inhabitants of Dominica demonstrated the following results: 1) A greater tendency towards hyperopia over myopia (the most frequent refractive errors fell in the +0.50D to +2.00D range) in all age groups with the highest frequency of myopia occurring in the 20-39 year age group, occurring more frequently in males than females; 2) Astigmatic refractive errors are common in all age groups with the most frequently found cylindrical refractive error being –0.50D, and the most common axis orientation being approximately 90 degrees (in minus cylinder formation); 3) Pterygia were found in 10.1% of the sample population, with the highest frequency occurring in those patients 40 years old and up, 16.3% of those in this age range were documented as having pterygiums in one or both eyes; 4) Approximately 3.4% of the population was found to have various ocular anomalies/pathologies for which a referral to the local ophthalmologist was made.

In reference to the findings of this sample population, various assumptions, theories and ideas were considered and discussed regarding various ocular conditions. Areas in which further studies may be useful were discussed along with theories presented by other studies.

It is hoped that the information contained in the study will be useful in aiding those who wish to help in meeting the visual needs of the Dominican population so that these people may be better served and enjoy the gift of sight. As a future optometrist it is my duty to aid in the visual well being of others and it is my hope that this study will be useful for those who care for the people of Dominica.

ACKNOWLEDGMENTS

A special thanks goes to following for their input, support and assistance in making this study possible: Daniel Wrubel, O.D., The 1997 Michigan-VOSH Dominica Team, The Rotary Club of Dominica, The Government of Dominica, and the local ophthalmologist of Dominica, Dr. Hazel Shillingford-Ricketts.

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