5-2002

Prevalance of ocular disorders from three communities in Oregon

Concetta Di Zazzo
Pacific University

Beverly Klizer
Pacific University

Prevalance of ocular disorders from three communities in Oregon

Abstract

Objective: The goal of this study was to understand and categorize the patients seen by interns at several Pacific University College of Optometry clinics.

Methods: We performed a retrospective study of the files contained within 3 of the 5 Pacific University affiliated clinics that have ongoing patient care. 300 patient records were reviewed at the largest clinic, Forest Grove, 205 from the downtown Portland clinic, and 100 from the Virginia Garcia clinic. Information was collected on patient demographics, chief complaint, symptoms and disorders, the 21-point exam and clinical diagnoses.

Results: Demographically all three clinics show patient bases of equal numbers of females and males. The Virginia Garcia clinic was 95 % Hispanic whereas the other two clinics showed smaller ethnic/ minority population proportions. The most common reasons patients came to our clinics was for a regular eye checkup, blurred vision near, far or both. The third most common reason overall, and the most common for Virginia Garcia patients, was for diseases-like symptoms. The most common complaints checked on the intake form were blurred vision, headaches and irritated eyes. Both Portland and Forest Grove patient files reported myopia as the most prevalent type of ametropia whereas in Virginia Garcia; emmetropia was the most prevalent. The study also found that although Pacific University teaches the 21-point eye exam, interns do not seem to gather enough information on what is termed" complete eye exams" to make conclusive diagnoses of binocular disorders. Furthermore, although one of the goals of this study was to describe the demographics of the clinic's patient populations, the amount of information collected from the patient records was limited.

Conclusion: The study shows that Virginia Garcia has a large Hispanic component and that their chief complaints are more often disease oriented than for blurry vision. Also our study indicates that Vision Therapy should be offered in English and in Spanish at either the Virginia Garcia and Forest Grove clinic at least once a week since there is greater amount of amblyopia found in these clinics. Lastly, training at Pacific University and each of the affiliated clinics should stress more the importance of collecting complete information during patient interviews and eye exams.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Willard B. Bleything

Subject Categories

Optometry

PREVALANCE OF OCULAR DISORDERS FROM THREE COMMUNITIES IN OREGON

By

Concetta Di Zazzo,

And

Beverly Kilzer

A thesis submitted to the faculty of the

College of Optometry

Pacific University

Forest Grove, Oregon

In partial fulfillment for the degree of

Doctor of Optometry

May 2002

Advisor: Willard B Bleything, OD, MS

Distinguished University Professor

PREVALANCE OF OCULAR DISORDERS FROM THREE COMMUNITIES IN OREGON

Students

Concetta Di Zazzo

Beverly Kilzer

Advisor

Willard B. Bleything, OD, MS

Biographies:

Concetta Di Zazzo:

Born and grew up in Montreal, Quebec, Canada. During high school she was on the swim-team, and was part of the pastoral committee. Went to McGill University where she graduated with a Bachelor of Science, major in genetics, minor in psychology. In 1996 she and two other educators found and directed their own Day camp in the city and an overnight camp in the Lauartiens. In 1998 she began optometry school at Pacific University. She enjoys skiing, tennis and playing golf. Upon graduation she plans to work optometric environment that provides in-house vision therapy and primary care.

Beverly Kilzer:

She is originally from Bentley, ND. She grew up on a farm and attended St. Vincent's grade school and then Mott Lincoln high school. She attended North Dakota State University majoring in Zoology and minoring in Chemistry and Biology. She is interested in many outdoor recreational sports including: downhill skiing, windsurfing, running, and scuba diving; as well as indoor hobbies including: building my personal web page and painting. Upon graduation she plans to practice in the upper Midwest, in a private practice.

ABSTRACT

Objective: The goal of this study was to understand and categorize the patients seen by interns at several Pacific University College of Optometry clinics.

Methods: We performed a retrospective study of the files contained within 3 of the 5 Pacific University affiliated clinics that have ongoing patient care. 300 patient records were reviewed at the largest clinic, Forest Grove, 205 from the downtown Portland clinic, and 100 from the Virginia Garcia clinic. Information was collected on patient demographics, chief complaint, symptoms and disorders, the 21-point exam and clinical diagnoses.

Results: Demographically all three clinics show patiént bases of equal numbers of females and males. The Virginia Garcia clinic was 95 % Hispanic whereas the other two clinics showed smaller ethnic/minority population proportions. The most common reasons patients came to our clinics was for a regular eye checkup, blurred vision near, far or both. The third most common reason overall, and the most common for Virginia Garcia patients, was for diseases-like symptoms. The most common complaints checked on the intake form were blurred vision, headaches and irritated eyes. Both Portland and Forest Grove patient files reported myopia as the most prevalent type of ametropia whereas in Virginia Garcia; emmetropia was the most prevalent. The study also found that although Pacific University teaches the 21-point eye exam, interns do not seem to gather enough information on what is termed " complete eye exams" to make conclusive diagnoses of binocular disorders. Furthermore, although one of the goals of this study was to describe the demographics of the clinic's patient populations, the amount of information collected from the patient records was limited.

Conclusion: The study shows that Virginia Garcia has a large Hispanic component and that their chief complaints are more often disease oriented than for blurry vision. Also our study indicates that Vision Therapy should be offered in English and in Spanish at either the Virginia Garcia and Forest Grove clinic at least once a week since there is greater amount of amblyopia found in these clinics. Lastly, training at Pacific University and each of the affiliated clinics should stress more the importance of collecting complete information during patient interviews and eye exams.

Acknowledgement:

We thank the Forest Grove vision clinic's, Virginia Garcie Vision clinic's and Portland vision clinic's staff members for their cooperation while we gathered the data for our thesis.

TABLE OF CONTENTS:

LIST OF FIGURES:

LIST OF TABLES:

INTRODUCTION

As part of the education process for optometric students at Pacific University College of Optometry, all students upon graduation must complete a rotation through the school's clinics. In order to see the demographics of patients our students are seeing and to compare these demographics with previous literature we designed a retrospective study using a random sample of patients from three of the five clinics run by Pacific University.

The clinic experience for students includes, working in groups of two seeing patients, under supervision by am attending doctor, one half day a week for the summer session. When the student has encountered 9 patients they are ready to see patients individually. This training continues, one afternoon a week, for the remainder of the third year of the program. In the fourth year, interns go through three rotations of 14 weeks in the clinics during their preceptorship. One of these rotations is carried out at the Pacific University vision centers around Portland, Oregon. Exposure to a wide range of ocular disorders and diverse patient populations is therefore important for the education of interns at Pacific University. We, therefore, performed a study of three clinics participating in the clinical training of Pacific University interns to evaluate what type of patients the College of Optometry is providing care for, and to identify the level of training our students are getting.

Pacific University believes in teaching comprehensive care including functional optometry. This explains why our study looks into the 21-point exam and if our examiners are recording enough information to do analysis on the data points to obtain a complete diagnosis of binocular disorders. Because Pacific University's program is functionally based, we ran an analysis on the records to establish a visual profile of the patients coming to these clinics.

The intake form was important to us because Pacific University believes in extensive history taking. The intake form has most of the common symptoms patients present with in an exam using a checklist system. The chief complaint was recorded in the actual words of the patient at the time of the interview.

This study will also provide information on the demographics of patient populations found in the Northwest and make comparisons between the three clinics reviewed. Given the significant Hispanic population in one of the clinics, particular attention was also given to this minority group.

All the patients in our random sample for the downtown Portland clinic listed their home address as Portland; while those who came to Forest Grove for exams listed their address as Forest Grove, Gaston, Cornelius, Aloha or Hillsboro; and those who received exams from Virginia Garcia live in Beaverton, Cornelius, Aloha, or Hillsboro.

The intake form includes a checklist format that patients mark with their concerns. It has questions about occupational needs and hobbies along with other aspects of daily visual requirements. It also includes a question about contact lens wear. The intake form can be used by interns to begin probing for case history symptoms patients are experiencing or spark interest in modes of treatment, such as contact lenses. It may also serve as a good opportunity for interns to practice patient management and to generate interest in more patients on the use of contact lenses. This study looked at the intake form to gather extra information that is in the patient's record but would be missed if not taken into account.

We selected guidelines for categorizing the files into specific conditions. We chose the most common definitions, by other studies, of refractive errors (RE) for ease of comparing our data to the other studies. We also chose to research education level of every patient. In previous studies education has been associated strongly with risk of myopia[1]. We chose to compare our patients to their education level as well as RE to see if there was an association.

Some of the areas we chose to analyze were ones studied before. We looked at Age and RE because in a previous study the two were correlated such that hyperopia increased with increasing age, as well as astigmatism and anisometropia, while myopia decreased[1]. We also looked at gender differences in RE. Our sources stated that females had significantly more RE than males[2,7]. The prevalence of strabismus was noted as 5.3%, anisometropia 13.1% and amblyopia 1.7% in a sample of school children[3].

Each disease was assigned an International Classification of Diseases Code number (ICD-9) for computer analysis as was done in other studies[2]. Our definition of amblyopia was 20/40 or worse[3].

METHODS

This is a retrospective study that looked at the population in three Pacific University affiliated clinics: Virginia Garcia, Portland and Forest Grove. The case files were randomly selected to evaluate a fixed number of files for each clinic; 300 files from Forest Grove, 100 from Virginia Garcia, and 205 in Portland. Patient files were sorted by alphabetical order for each clinic and given a placement number. The sample files were then selected at random using a random number generator in Excel (Microsoft, Seattle, WA). Random numbers were derived without duplication from the list of patient files based on a preset weighted proportion in each clinic: 5.5% for Forest Grove, 7.5% for Virginia Garcia, and 5.6% for Portland. A higher proportion of files were collected from the smaller clinics to increase statistical power at the clinic level totaling to 605 patient files overall. Patient files were identified using a unique identifier code, which were kept separate from the primary database to ensure patient confidentiality.

The guidelines used in this study were chosen based on the approach used by similar studies that have been done in the past. This study's cut-off points were selected to resemble those of the previous studies in order to make comparisons readily possible. Refractive error cut offs were selected based on studies by Grosvenor [4], Griffin et al. [5], Chen et al. [2], and Katz et al. [1]. Cut offs for astigmatism and anisometropia were based on criteria defined by Katz et al. [1] and Bennett et al. [3], respectively.

Collection of Demographic and Clinical Measures

Data from optometric charts were collected on computer using Filemaker for Windows (Claris Corp., Santa Clara, CA). An electronic questionnaire form was developed to facilitate data entry while reading patient files at each of the clinics. Data entry was performed by two optometry interns. Quality control was performed by randomly verifying independently 10% of the patient files entered to check for errors. Verification was also done by looking for outlying or extreme values. Demographic characteristics included: date of birth and age (in years); gender; ethnicity/race (Caucasian, African, American, Asian, Hispanic, Other, None); and level of education (Grade school, High School, Undergraduate, Graduate, Professional, Homemaker, Retired, Other, None).

Clinical measures were likewise abstracted from patient files going back from the last recorded clinic visit to 1998. Only these patients that had come in for a complete comprehensive exam were included in the study. Vision test results used in this investigation were the following: lateral phoria; base out (BO) blur, break and recovery far and near; base in (BI) blur, break, and recovery far and near; vertical phoria; Hirshberg test (both eyes); visual acuity (VA) unaided at far (right, left and both eyes) and VA unaided at near (right, left and both eyes); subjective near refraction (right and left); near VA (right and left); VA through patient's subjective refraction (right and left); interpupillary distance (PD); near point convergence (NPC)/Break distance; NPC/Recovery distance; and subjective refractive sphere, cylinder, and axis (right and left).

Other clinical measures included: the patient's chief complaint or reason for the clinic visit; most common symptoms reported either by self-report from the intake form or gathered by the intern during the case history interview (headaches, dizziness, dry eyes, eye injury, eye infection, blurred vision, double vision, poor night vision, eye surgery, poor depth perception, flashes, motion sickness, crossed eyes, irritated eyes, low reading comprehension, presence of floaters in visual field); and clinical diagnosis rendered at the last visit.

Information on whether patients had been asked about certain symptoms, contact lens use or whether a Hirschberg test had been performed were also collected.

Statistical Analysis

Prevalence of clinical diagnosis was calculated for the period from 1998 to 2000. All statistical analyses of clinical measures were stratified according to clinic location. The final database was then imported into the statistical program SPSS version 10 (SPSS Inc., Chicago, IL) for analysis. Patient demographics and clinical characteristics were evaluated by descriptive statistics including arithmetic mean, standard deviation (SD) and proportion based on valid responses. Seventy-one subjects who had record of only eye diseases visits and no complete eye exam were excluded from all statistical analyses of clinical measures. Restriction based on disease status and age (<9 years) or NPC status (>0.00 cm) was also performed for certain analyses including the Hirschberg test and NPC, respectively. Further

restriction was done on the basis of clinical diagnosis for the analysis of amblyopic subjects excluding all diagnoses of cataract.

Coding for Refractive Error Measures

Criteria used for coding for type of refractive error were based on the sphere power of the right eye. Subjects coded as myopic had to have more than –0.50 diopters. Hyperopia was coded for those with greater than 0.50 diopters and astigmatism of any value. Those within +0.50 to –0.50 diopters were labeled as emmetropic.

The level of anisometropia was based on the difference between Rx sphere for the right eye (OD) and Rx sphere for the left (OS). Subjects with a difference in sphere <-1.50 or >1.50 were classified as anisometropic and those with >-1.49 or <1.49 difference as non-anisometropic.

Axis OD results were grouped into 'with the rule' (1-30 and 150-180), 'against the rule' (60 thru 120), and 'oblique' (31-59 and 121-149) astigmatism. Subjects with no results were coded as unknown and those with zero axis OD were coded as 'spherical'.

For amblyopia the criteria was any vision acuity through best-corrected vision of worse than 20/40 on either eye. All Dwain White classifications were based on normative analysis criteria. Convergence insufficiency (CI) was based on phoria at far and near and BI and BO at near and NPC. For convergence excess (CE) we looked at near and far phoria, NPC and BI and BO at near. Coding for divergence insufficiency (DI) involved phoria at near and far, and BI and BO at far. Divergence excess (DE) was calculated based on phoria at near and far, and BI and BO at far.

The following calculations and values were used; the lateral phoria at far value = the distance phoria + 0.5) / 1.7; lateral phoria at near value = lateral phoria at near + 0.4) / 1.7; BI break at the far value = far base in break - 8.0) / 2.2);BO break at far value =base out break at far - 19.0) / 4.6; BO break at near value =base out break at near - 19.0) / 4.7); NPC calculated value = NPC break - 6.4) / 1.8;base in break value =BI break at near - 20.0) / 2.8). An alternate Dwain White classification system was also used without considering NPC break results in the selection criteria.

Positive relative accommodation (PRA) and negative relative accommodation (NRA) were calculated using the following formulas: PRA = (PRA binocular blur – Rx sphere OD); NRA = (NRA

binocular blur – Rx sphere OD). Net 14B was likewise calculated as: (Binocular JCC at near (#14BOS) – Rx sphere OS).

The following criteria were used to classify subjects according to the above measures: If the difference between far and near lateral phoria is < 1.0 or > -1.0, and lateral phoria at near and far are each >1.0 then classified as 'basic eso'; if the difference between far and near lateral phoria is < 1.0 or > -1.0, and lateral phoria at far value is < -1.0 and lateral phoria at near value is < -1.0) then classified as 'basic exo'; if the difference between far and near lateral phoria value is > 1.0 or the difference between far and near lateral phoria value is < -1.0 and the lateral phoria at far value is > the lateral phoria at near value, and base in break at far value is < -1.0, then classification 'divergence insufficient'; if the difference between far and near lateral phoria value is > 1.0 or the difference between far and near lateral phoria value is < -1.0) and lateral phoria at far value is > lateral phoria at near value and base out break at far value is < -1.0) then classified as 'divergence excess'; if the difference between far and near lateral phoria value is > 1.0 or the difference between far and near lateral phoria value is < -1.0) and lateral phoria at far value < lateral phoria at near value and base out break at near value < -1.0 and NPC calculated value is > 1.0) then classified as 'convergence insufficient'; and if the difference between far and near lateral phoria value is > 1.0 or the difference between far and near lateral phoria value is < -1.0) and lateral phoria at far value is < lateral phoria at near value is and NPC calculated value is < -1.0 and base in break at near value is < -1.0 then classified as 'convergence excess'. Otherwise subjects were classified as 'normal'.

RESULTS

One purpose of this study was to determine why people present themselves at three University' affiliated clinics in Oregon. The second objective was to look at the frequency of different disorders seen at the clinic.

Six hundred and three patient files were evaluated from three clinics in the Portland area: 300 (49.8%) from Forest Grove, 205 (34%) from Portland and 98 (16.3%) from Virginia Garcia. Age at the last visit could be calculated for 593 patients. Patient ages ranged from infant (less than one year) to 88 years with a mean age of 34.1 years (median=32). Overall there were more male patients 314 (52.3%) though gender was not reported for three patients. Ethnic/racial backgrounds were reported for 299 patients including 164 Caucasians (54.8%), 105 (35.1%) Hispanic, 9 (3.0%) Asian, 7 (2.3%) African American and 14 (2.3%) were from other backgrounds.

Demographic Characteristics

Figures 1.1 to 1.3 show the patient age distributions for the three clinic sites. Patients tended to be older at the Portland (mean=39.0, median=40-41 years) and Forest Grove (mean=32.8, median=27 years) clinics, and younger at Virginia Garcia (mean=27.56, median=24 years). Across the different clinic locations, patients were predominantly Caucasian for the Portland (N=101, 76.5%) and Forest Grove (N=60, 75.0%) clinics whereas Virginia Garcia was almost exclusively Hispanic (N=83, 95.4%). The distribution of female gender for the three clinics varied: 55.0% for Forest Grove, 48.8% in Portland and 51.5% in Virginia Garcia.

A descriptive finding of the population seen at Forest Grove clinic is that the mean interpupillary distance was 60.74mm (SD +/- 4.26mm) with a range of 50-70mm. In Virginia Garcia the mean interpupillary distance is 59.38mm, (SD +/- 4.19, range of 50 – 67mm). Whereas the mean papillary distance found in the Portland patients was 61.80mm (SD +/- 3.59, range 54-70mm).

Chief Complaints and Symptoms by Clinic

Table 1 shows the chief complaints patients reported by clinic site. In Forest Grove the most common reason for a visit was for an annual checkup (28.9%). Many patients also reported blurred vision at distance or near or both at far and near (21.7%). The third most common need was to inquire about contact lenses (9.2%). Thirty five percent of the patients seen by the Forest Grove interns came in for other reasons than those previously mentioned, these included screeners, color vision test, low vision and Glaucoma checks.

The Virginia Garcia vision clinic is an extension of the Virginia Garcia medical clinic. Most patients are usually referred to the eye clinic due to symptoms and objective findings concerning their eyes. Those making the referral are primary care medical staff. The most common reason Virginia patients attended the clinic was due to concern about the development of an eye disease, either by self-diagnosis or referred by the medical clinic (22.8%). The next common reason patients came in was that they had blurred vision at far, near or both far and near (25.5%). Less common was the need for an eye checkup that was thought to be the cause of their headaches.

In the Portland vision center the most common "complaint" was for a complete routine eye checkup (18.9%), followed by blurred vision at far, near or near and far which collectively represented 28.8% of the complaints. The third most common was due to an eye disease (8.5%).

Table 2 shows the percentage of patients experiencing the different symptoms asked on the intake form or by the intern. The table also reports the percentage of patients that were not asked about these symptoms either on the intake form or during the case history interview. The most common symptoms Forest Grove patients reported were blurred vision (36.6% of the patient files), headaches (33.2%) and irritated eyes (25.0%). At the Virginia Garcia vision center patients fill out a Spanish or English intake form depending on their primary language. In Virginia Garcia the most common symptom reported was blurred vision (55.9%), irritated eyes (46.3%) and headaches (42.6%). In the Portland clinic the top three most commonly reported symptoms were, likewise, blurred vision (48.1%), headaches (32.3%) and irritated eyes (25.8%). On the intake form contact lens use and interest are also addressed. Of the 73.6% patients seen in Forest Grove clinic, 30 % of them were interested or had worn contact

lenses whereas 94.3% Virginia Garcia of patient reported being interested or having worn contact lens. Of the files from the Portland clinic only 18.2% of the patients were interested or had worn contact lenses.

Clinical Diagnoses by Clinic

We also examined the prevalence of different diagnoses made for each of the clinics. Table 3 shows the frequency of clinical diagnoses rendered based on International Classification of Disease Codes Version 9 (ICD-9). Subjects could have received more than one diagnosis at any given visit resulting in more diagnoses than subjects for each clinic. The majority of patients were evaluated and treated for refractive errors and accommodative disorders at all three clinics; 73.0% Forest Grove, 57.4% Virginia Garcia, and 69.8% Portland. The next most common diagnosis at the Forest Grove clinic was for strabismus and binocular eye movements, 4.2%. At the Portland and Virginia Garcia clinics, the second most common diagnosis was for conjunctival disorders (4.8% to 14.9%, respectively).

Prevalence of Refractive Errors

Figure 2 shows the number of refractive errors that exist among the three clinic sites. The distribution of ametropia in Forest Grove was divided up into three groups: 29.7% of patients seen were emmetropic, 38.4 % were myopic and 31.9% of the patients were hyperopic. In Virginia Garcia 41.0% of the 78 patient files were emmetropic, 25.6% were myopic, and 33.3% of the patients were hyperopic. The prevalence of ametropia among 183 patients in the Portland clinic was distributed as follows: 32.8% emmetropic, 44.8% myopic and 22.4% hyperopic.

Figure 3 looks at the percentage of amblyopes in the different clinics. Amblyopia was seen in 6.0% of the patient files from the Forest Grove clinic, in 6.1% of the patient files in the Portland clinic and 12.3% of the files from Virginia Garcia (Figure 3). Anisometropia was seen in 4.4% of the patient files in the Forest Grove clinic, 4.5% in Virginia Garcia and 10.3% in Portland clinic.

Table 4 describes the mean, mode and range of BI range and BO range as well as for phorias and ductions, both at infinity and at 40 cm for each of the three clinics. Looking at the files gathered tables 3.1,3.2,3.3 show the binocular findings and the number of files in which this information was gathered. As

one can see the least measured skill was BI break at far at the Forest Grove clinic, BO blur in Virginia Garcia and BO blur in Portland.

Astigmatism and Rx Sphere

Figure 4.1 shows that the mean subjective sphere power for the Forest Grove Clinic was –1.11 diopters, (SD +/- 2.58 diopters), ranging from –10.50 to +5.50 diopters. Of those patients who were not emmetropic, 36.0% had a spherical subjective refractive error and 64.5% of the patient files showed astigmatism. Figure 5.1 shows the mean subjective cylinder power of patients was –0.50 diopters, with a range of 0.00 diopters to –5.00 diopters. The distribution of the different types of astigmatism was as follows; 39.2% had with the rule astigmatism, 48.1% had against the rule astigmatism, and 12.7% had oblique astigmatism (Figure 6). Figure 7.1 shows that the minimum plus for 20/20 vision at near was +1.42 diopters (SD +/- 0.84 diopters). Note that 81% of the patients actually needed a near add of greater than +0.75 diopters.

Figure 4.2 shows that of the Virginia Garcia clinic patients evaluated, the mean subjective sphere power was 0.00 diopters (SD +/- 2.67 diopters), with a range of –19.00 to +5.00 diopters. Of the non-emmetropic patients from Virginia Garcia, 39.7% had a spherical subjective refractive error and 60.3% had astigmatism. Figure 5.2 shows Virginia Garcia Vision Clinic patients mean subjective cylinder power was –0.70 diopters, with a range of 0.00 to –5.50 diopters. 61.7% of the astigmatic patients from Virginia Garcia had with the rule astigmatism, 31.9% had against the rule and 6.4% had oblique astigmatism (Figure 6). Figure 7.2 shows the distribution of minimum plus for 20/20 vision at near 1.87 diopters (SD +/- 0.74). Note 90% patient files looked at Virginia Garcia needed an add of 0.75 diopters or more.

Figure 4.3 describes the distribution of the subjective sphere of Portland patients. The mean subjective sphere power was -1.23 diopters (SD 4.11 diopters; range –35.75 to+17.50 diopters) (Figure 5.3). Of the Portland patients who were not emmtropic, 28.4% had a spherical subjective refractive error and 71.1% of them had astigmatism. The mean subjective cylinder power was –0.61 diopters, (range of 0 to –3.75 diopters). The distribution of the type of astigmatism among the Portland clinic patients was: 46.0% with the rule, 43.7% against the rule astigmatism and 10.3% had oblique astigmatism (Figure 6).

The mean subjective near add was 1.70 diopters (std.+/- 0.78). More than 94% of Portland patients needed a near add of at least 0.75 diopters (Figure 7.3).

Prevalence of Refractive Errors versus Education Level

Figure 8 displays the distribution of refractive error in association with the different levels of education. In Forest Grove (Figure 8.1), myopia was more frequent in patients with at least an undergraduate college education and least frequent in those completing only grade school. Note that the numbers in Figure 8.1 are based on 125 cases not 300 (due to missing information).

For the Virginia Garcia Vision Clinic we found the same pattern as seen with the Forest Grove clinic (Figure 8.2). However, the analysis for Virginia Garcia included only 26 patient files, due to missing data. The same pattern was also seen in the Portland clinic though 40 files had enough information to run this analysis (Figure 8.3).

Performance of Hirschberg Tests in Children

For patients under 8 years of age, the American Optometric Association (AOA) suggests that a Hirschberg test be done. Of the 18 patients in Forest Grove that were 8 years or younger only 3 (18.2%) pediatric patients had this information in their file. In Virginia Garcia there were 13 files pulled from children 8 years old or younger of which only 4 (30.8%) had this measure in their files. The Portland files revealed that out of 10 children under 8 years, only 2 (16.7%) had this measurement in their file.

Dwain White Classifications

This study also looked at the number of Dwain White (DW) classifications based on analysis of the data gathered. Using Dwain White classification criteria and normative analysis norms the following information was found from the Forest Grove files (Table 5). Based on only the phorias and BO / BI ranges, 25.0% of the cases seen in the Forest Grove clinic had divergence excess, 9.8% had convergence excess, and 6.5% were basic eso. Patients with basic exo and divergence insufficiency both had a prevalence of 3.3%. Convergence insufficiency was found in only 1.1% of the 92 cases from whom these criteria could be run since not all the files had the necessary data to decipher the categories. The

number of files that had enough test information in Forest grove, Virginia Garcia, Portland was 91(33.0%), 6 (7.7%), 21 (11.5%) respectively. If NPC is considered as well as the above criteria, the number of convergence insufficiency and convergence excess patients decreased. In Virginia Garcia fours cases (66.7%) had basic eso and one (16.6%) had convergence excess. There was no difference when criteria did not include NPC results. Comparatively, the Portland clinic had 14.3% of the cases with basic eso, 38.1% with divergence excess and 4.8% with convergence excess. Again the proportions were very similar after dropping NPC.

Figure 1.1: Age distribution of the files from Forest Grove

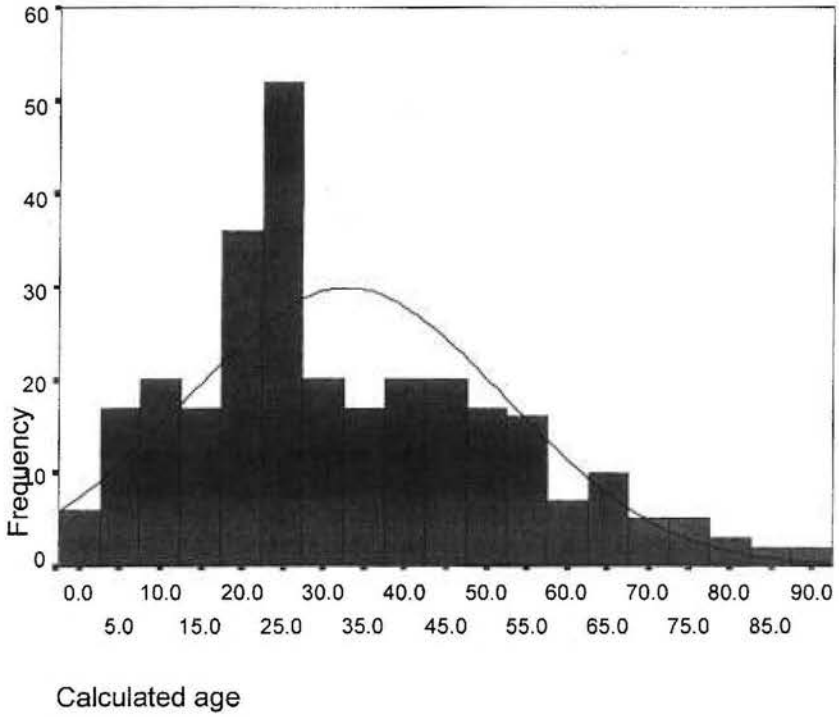

Figure 1.2: Age distribution of the files from Virginia Garcia

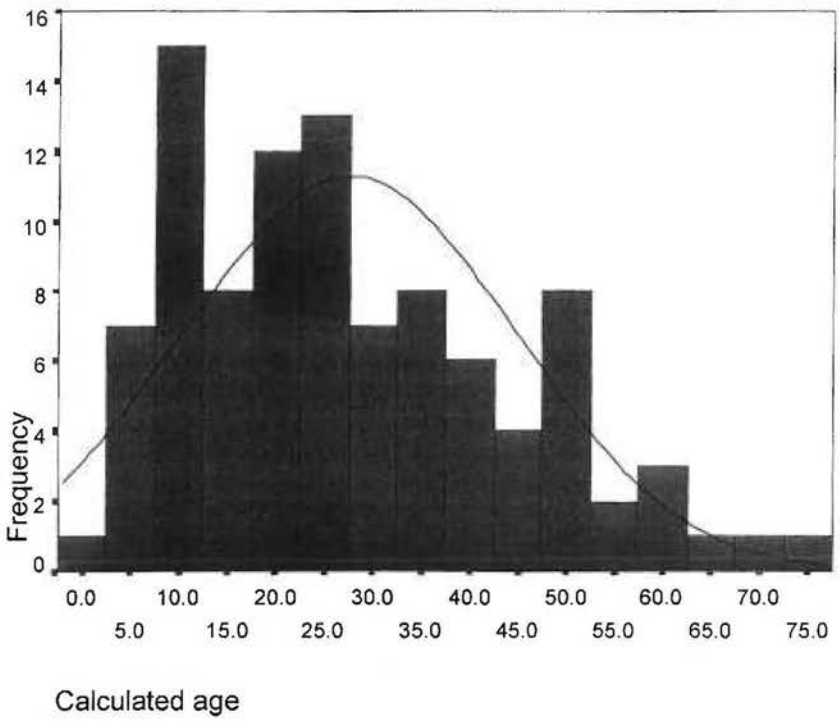

Figure 1.1: Age distribution of files from Portland

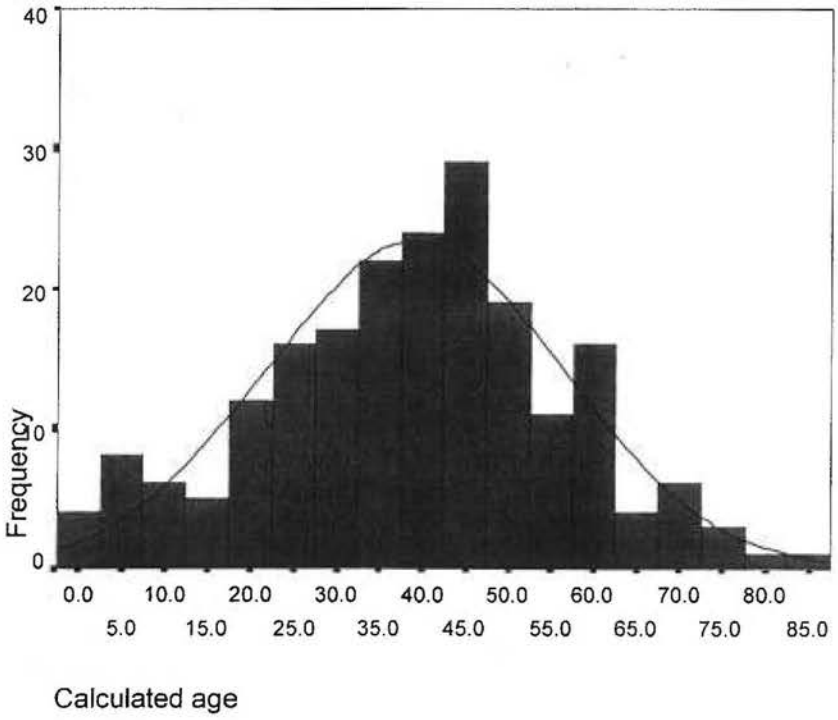

Table 1. Frequency and percentage of chief complaints reported at each clinic.

Chief Complaint	Forest Grove		Virginia Garcia		Portland	
	No.	Percent	No.	Percent	No.	Percent
Eye checkup	88	28.9%	8	7.0%	40	18.9%
Contact lens	28	9.2%	3	2.6%	15	7.1%
Blur at far	25	8.2%	14	12.3%	26	12.3%
Blur at near	24	7.9%	9	7.9%	23	10.8%
Blur at far and near	17	5.6%	6	5.3%	12	5.7%
Diseases	17	5.6%	26	22.8%	18	8.5%
Broke Glasses	13	4.3%	2	1.8%	9	4.2%
Lost glasses	3	1.0%	2	1.8%	3	1.4%
New glasses	2	0.7%	1	0.9%	9	4.2%
Red eyes	11	3.6%	6	5.3%	6	2.8%
Headaches	7	2.3%	12	10.5%	5	2.4%
Headaches at near	4	1.3%	8	7.0%	2	0.9%
Screeners	6	2.0%	1	0.9%	1	0.5%
Failed school screener	6	2.0%	5	4.4%	0	0.0%
Reading problems	13	4.3%	4	3.5%	7	3.3%
Computer Problems	6	2.0%	0	0.0%	4	1.9%
Night vision problems	4	1.3%	0	0.0%	5	2.4%
VT pre/post evaluation	5	1.6%	0	0.0%	4	1.9%
Lasik pre/post evaluation	2	0.7%	0	0.0%	1	0.5%
Double vision	3	1.0%	0	0.0%	2	0.9%
Foreign Bodies	3	1.0%	3	2.6%	2	0.9%
Rx check	3	1.0%	2	1.8%	2	0.9%
Asthenopia	1	0.3%	0	0.0%	3	1.4%
Color test	3	1.0%	0	0.0%	0	0.0%
Low vision	2	0.7%	0	0.0%	3	1.4%
Diabetic Screeners	2	0.7%	1	0.9%	0	0.0%
Floaters	1	0.3%	0	0.0%	3	1.4%
Fill Rx	4	1.3%	1	0.9%	3	1.4%
Permit	1	0.3%	0	0.0%	1	0.5%
None	0	0.0%	0	0.0%	3	1.4%
Total	304	100.0%	114	100.0%	212	100.0%

Table 2: Most common symptoms reported by patients at each of the three clinics*

Common symptoms†	Forest Grove		Virginia Garcia		Portland	
	% Reported	Not asked	% Reported	Not asked	% Reported	Not asked
Headaches	33.2%	26.4	42.6%	12.8	32.3%	8.7
Blurred Vision	36.6	25.4	55.9	12.8	48.1	16.5
Double vision	9.1	27.9	11.8	12.8	6.1	10.9
Irritated eyes	25.0	26.8	46.3	14.1	25.8	10.9
Dry eyes	8.0	26.8	13.2	12.8	14.8	11.5
Dizziness	9 .0	26.8	16.4	14.1	8.6	10.9
Eye injury	2.5	27.5	6.0	12.8	6.7	9.8
Eye infections	4.0	27.5	5.9	11	9.1	10.4
Eye surgeries	1.5	27.9	1.5	11	2.4	9.8
Poor night vision	10.6	27.9	11.1	11	21.3	12.6
Low reading comprehension	4.5	27.2	2.5	83.3	5.0	12.0
Flashes	5.5	27.5	12.7	17.9	8.8	12.6
Poor depth perception	1.0	27.9	11.1	87.2	6.9	12.6
Floaters	10.1	27.5	13.4	14.1	24.4	12.6

* Analysis for Forest Grove is based on 276 cases out of 300 files, due to exclusion of those having only come in for emergency or a limited specific disease visit in the last two years of the last visit; 78/98 files were included for Virginia Garcia; and 183/205 files for Portland.

† Symptoms reported by either checking off the box on the intake form or by being asked by the Intern.

Table 3: Frequency and percentage of clinical diagnoses by clinic location.

ICD-9*	Clinical Diagnosis	Forest Grove		Virginia Garcia		Portland	
		No.	Percent	No.	Percent	No.	Percent
340-349	CNS	1	0.2%	0	0.0%	0	0.0%
350-359	Peripheral NS	1	0.2%	0	0.0%	1	0.2%
360	Globe	1	0.2%	1	0.4%	2	0.4%
361	Retinal detachment and defects	1	0.2%	0	0.0%	3	0.6%
362	Diabetic retinopathy, Microanyerisums	12	1.8%	5	2.1%	16	3.0%
363	Choroid disorder, scars, inflammations	5	0.8%	2	0.8%	4	0.7%
364	Disorders of ciliary body and iris	2	0.3%	2	0.8%	0	0.0%
365	Glaucoma	7	1.1%	2	0.8%	3	0.6%
366	Cataract	18	2.7%	4	1.7%	18	3.4%
367	Refraction and accommodation disorders	486	73.0%	139	57.4%	375	69.8%
368	Visual defects, amblyopia, color vision deficiencies	17	2.6%	13	5.4%	13	2.4%
369	Low vision and blindness	2	0.3%	0	0.0%	1	0.2%
370	Keratitis, corneal ulcer, edema, SPK neovascularization	8	1.2%	3	1.2%	8	1.5%
371	Kertoconus, pigment on cornea, corneal scar, corneal dystrophies	8	1.2%	3	1.2%	4	0.7%
372	Conjunctival disorders	26	3.9%	36	14.9%	26	4.8%
373	Inflammation of eyelids	20	3.0%	8	3.3%	20	3.7%
374	Entropian, ectropian, ptosis, lagopthalmus	2	0.3%	2	0.8%	3	0.6%
375	Disorder of lacrimal system	10	1.5%	10	4.1%	8	1.5%
376	Disorder of orbit, cellulitius, inflammatory	0	0.0%	0	0.0%	0	0.0%
377	Optic nerve, neuritis, visual pathways, optic atrophy, papillodema, drusen, neoplasm	0	0.0%	0	0.0%	2	0.4%
378	Strabismus and binocular eye movements	28	4.2%	3	1.2%	20	3.7%
379	Other eye disorders, scleral, episcleral disorders, vitreous, pupillary function, nystagmus	6	0.9%	4	1.7%	7	1.3%
v65.5	Emmetropia	5	0.8%	3	1.2%	0	0.0%
930	Foreign bodies	0	0.0%	2	0.8%	3	0.6%
	Total	666	100.0%	242	100.0%	537	100.0%

* International Classification of Disease version 9 (ICD-9) code.

Table 4.1: Descriptive statistics for BI, BO ranges and PRA and NRA for Forest Grove

		Forest Grove					
		Mean	SD +/-	Mode	Median	Range	No. Files
Distance							
	Lateral phoria	0.12eso	3.08	ortho	ortho	15exo- 9eso	188
	BO blur	12.16BO	6.44	12BO	12BO	0-28BO	59
	BO break	18.6BO	7.76	18BO	18BO	4BO-40BO	117
	BO recovery	9.07BO	5.62	12BO	9BO	2BI-38BO	116
	BI break	3.20BI	3.03	6BI	6BI	4BI-30BI	5
	BI recovery	4.12BI	3.70	4BI	4BI	18BI-8BO	11
	Vertical phoria	ortho	0.76	ortho	ortho	2Hypo-3Hyper	276
Near							
	Lateral phoria	3.3eso	5.52	6exo	4exo	18exo-20eso	177
	BO blur	12.8BO	8.40	10BO	12BO	0BO-40BO	56
	BO break	18.74BO	8.84	12BO, 18BO	18BO	6BI-40BO	155
	BO recovery	9.09BO	8.19	10BO	8BO	6BI-40BO	153
	BI break	16.50BI	6.09	18BI	16BI	0BI-32BI	148
	BI recovery	8.88BI	5.84	6BI	8BI	4BO-28BI	148
	Net 14b OD	-1.05	1.1	-1.25	-1	2.50-(-2.50)	167
	Net PRA	-1.88	2.66	-2.75	-2.12	(-11.25)-(5.50)	190
	Net NRA	2.4	0.96	3	2.50	(-3.00)-(4.25)	198

Table 4.2: Descriptive statistics for BI, BO ranges and PRA and NRA for Virginia Garcia

		Virginia Garcia					
		Mean	SD +/-	Mode	Median	Range	No. Files
Distance							
	Lateral phoria	0.28exo	3.16	2eso	ortho	15exo-4eso	43
	BO blur	12.67BO	4.62	10BO	10BO	10BO-18BO	3
	BO break	18.40BO	2.61	16BO	16BO	16BO-18BO	5
	BO recovery	8.00BO	4.69	4BO	6BO	4BO-14BO	5
	BI break	9.20BI	4.15	6BI	8BI	6BI-18BI	5
	BI recovery	4.40BI	3.58	4BI	4BI	0-10BI	5
	Vertical phoria	Ortho	Ortho	ortho	ortho	ortho-1hyper	21
Near							
	Lateral phoria	4exo	4.83	6exo	5exo	20exo-3eso	36
	BO blur	13.60BO	4.34	10BO	12BO	10BO-20BO	5
	BO break	22.25BO	1.72	24BO	22BO	12BO-40BO	16
	BO recovery	9.20BO	5.94	4BO, 8BO	8BO	0-22BO	15
	BI break	20.00BI	5.81	18BI	18BI	12BI-30BI	15
	BI recovery	8.13BI	4.26	6BI	8BI	0-18BI	15
	Net 14b OD	-1.18	0.76	-1.25	-1.25	2.75- (0.25)	31
	Net PRA	-1.74	2.23	-1.5	-1.5	(-9.00)-(2.00)	54
	Net NRA	2.4	2.54	2.5	2.25	(-2.25)-(3.75)	54

Table 4.3: Descriptive statistics for BI, BO ranges and PRA and NRA for Portland

		Portland clinic					
		Mean	SD +/-	Mode	Median	Range	No. Files
Distance							
	Lateral phoria	0.50eso	3.17	ortho	ortho	9exo-12eso	106
	BO blur	12.60BO	6.54	8BO, 12BO	12BO	2BO-26BO	10
	BO break	17.48BO	6.69	18BO, 24BO	18BO	6BO-30BO	27
	BO recovery	6.74BO	5.58	4BO, 6BO	6BO	0-24BO	27
	BI break	8.25BI	2.58	6BI	8BI	4BI-12BI	28
	BI recovery	3.68BI	3.27	2BI, 4BI	4BI	5BO-12BI	28
	Vertical phoria	ortho	1.92	ortho	ortho	3Hypo-15Hyper	79
Near							
	Lateral phoria	4.25eso	6.35	9exo,ortho	5exo	18exo-17eso	96
	BO blur	12.25BO	6.27	18BO	12BO	3BO-20BO	12
	BO break	15.98BO	7.53	18BO	16BO	4BI-32BO	63
	BO recovery	6.98BO	6.67	6BO, 12BO	6BO	8BI-24BO	62
	BI break	18.10BI	6.84	18BI	18BI	3BI-43BI	59
	BI recovery	11.56BI	5.92	12BI	12BI	2BI-31BI	59
	Net 14b OD	-0.51	1.41	-1.25	-1.5	(-12.75)-(0.75)	101
	Net PRA	-0.96	2.07	1.00	-1.00	(-7.25)-(4.75)	124
	Net NRA	2.66	0.91	3.25	2.75	(-1.75)-(4.50)	131

Figure 2: Distribution of ametropia for all three clinics

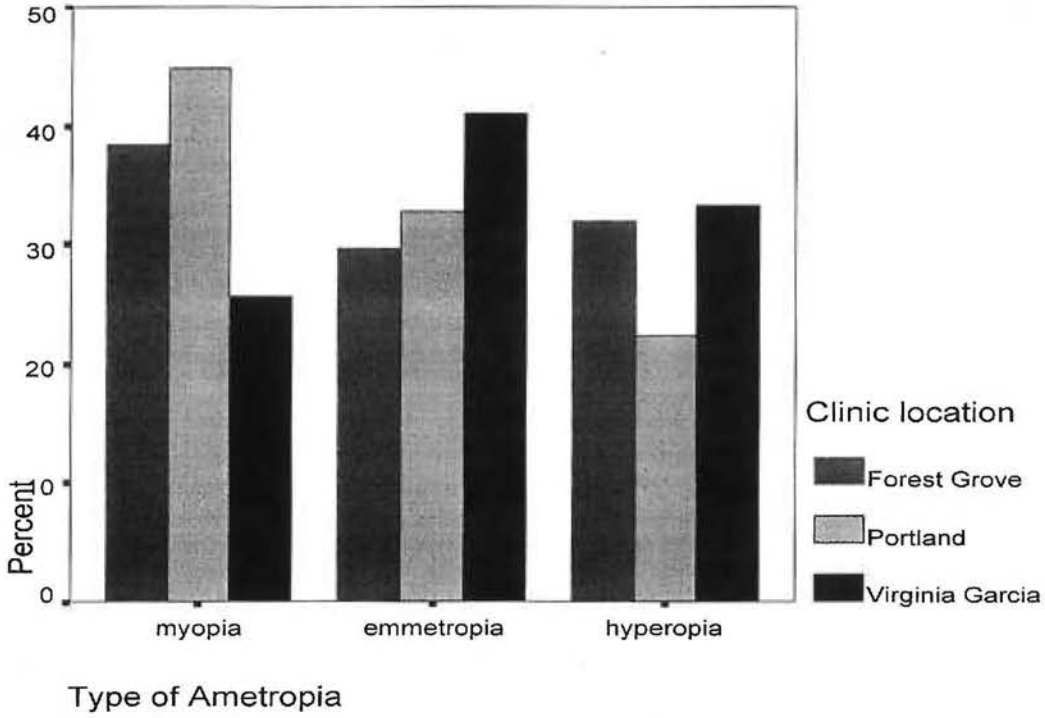

Figure 3: Percentage of amblyopic patients by clinic location

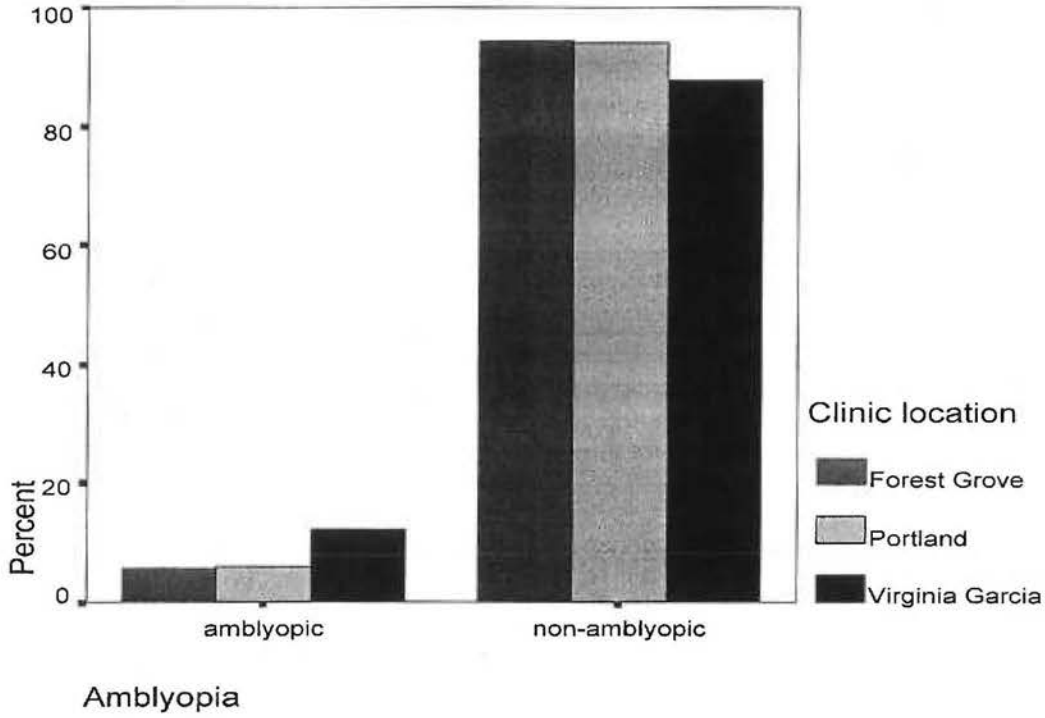

Figure 4.1: Distribution of subjective sphere power needed to achieve best visual acuity for Forest Grove

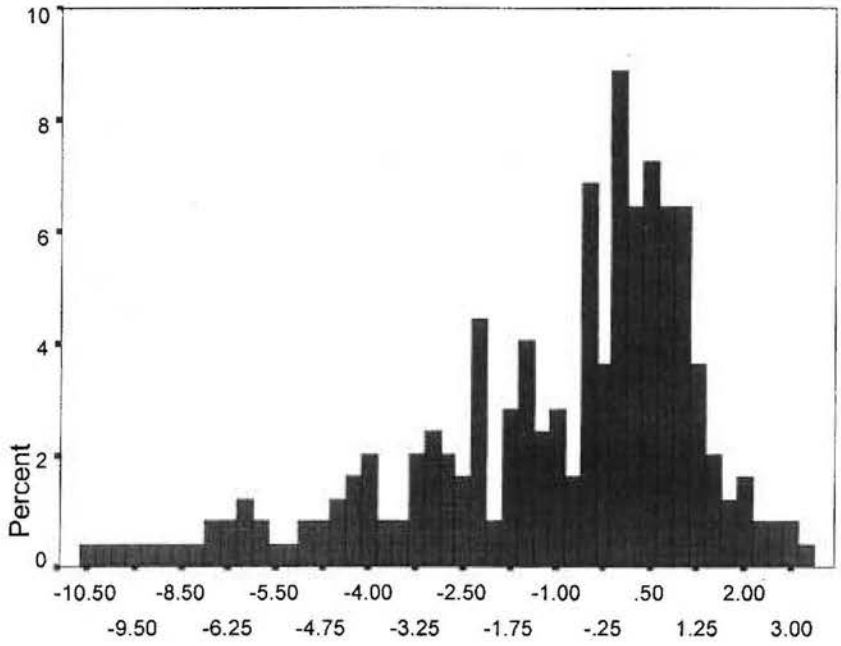

Figure 4.2: Distribution of subjective sphere power needed to achieve best visual acuity for Virginia Garcia

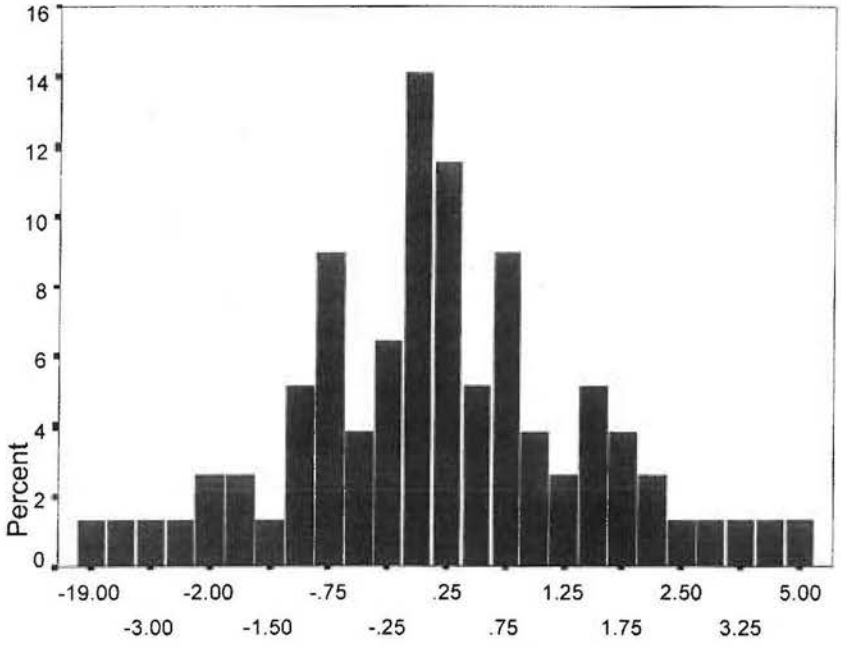

Figure 4.3: Distribution of subjective sphere power needed to achieve best visual acuity for Portland

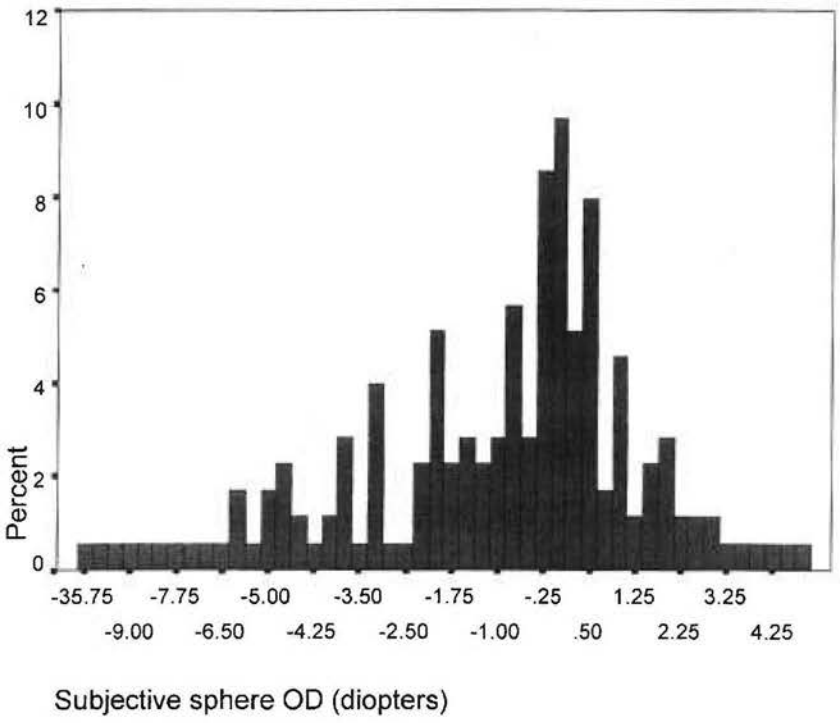

Figure 5.1: Distribution of subjective cylinder powers for Forest Grove

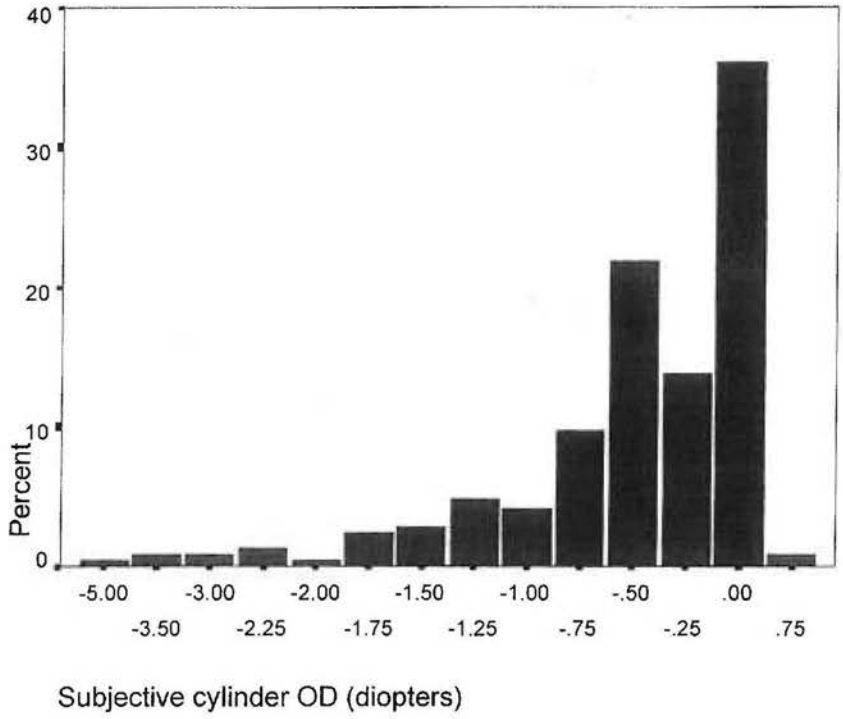

Figure 5.2: Distribution of subjective cylinder powers for Virginia Garcia

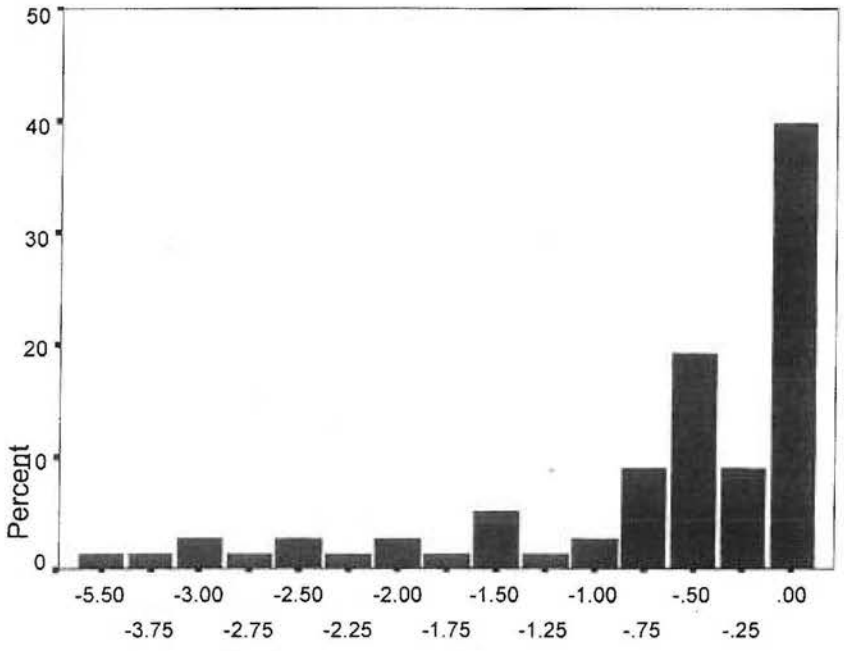

Figure 5.3: Distribution of subjective cylinder powers for Portland

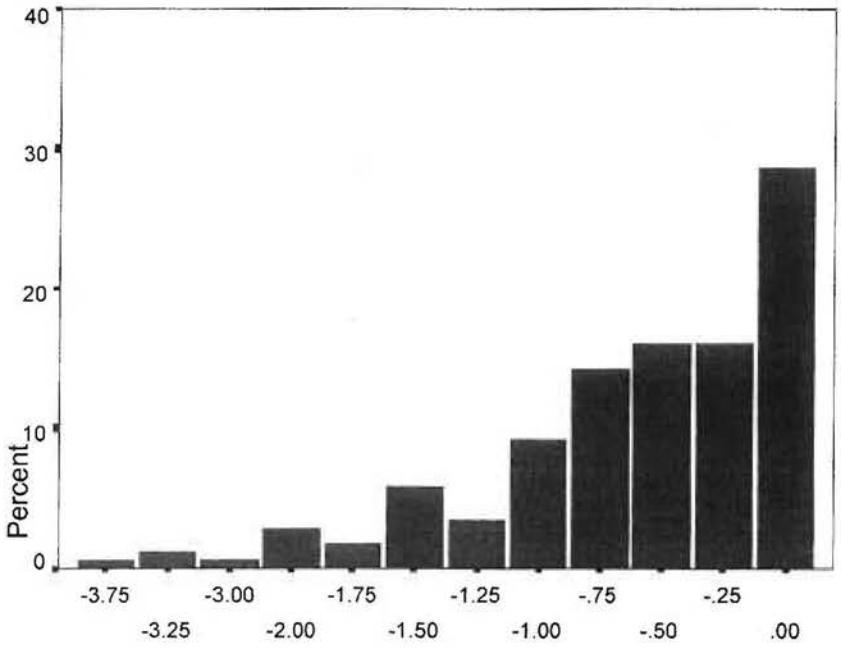

Figure 6: Distribution of different types of astigmatism in all three clinics

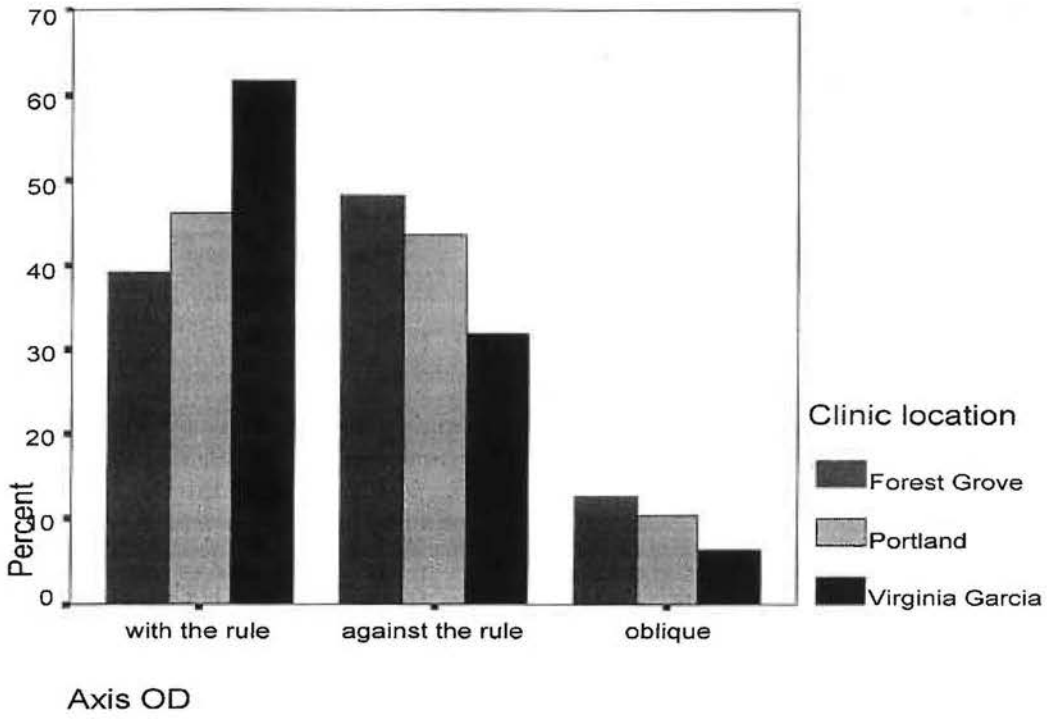

Figure 7.1: Distribution of subjective near add powers for the Forest Grove clinic

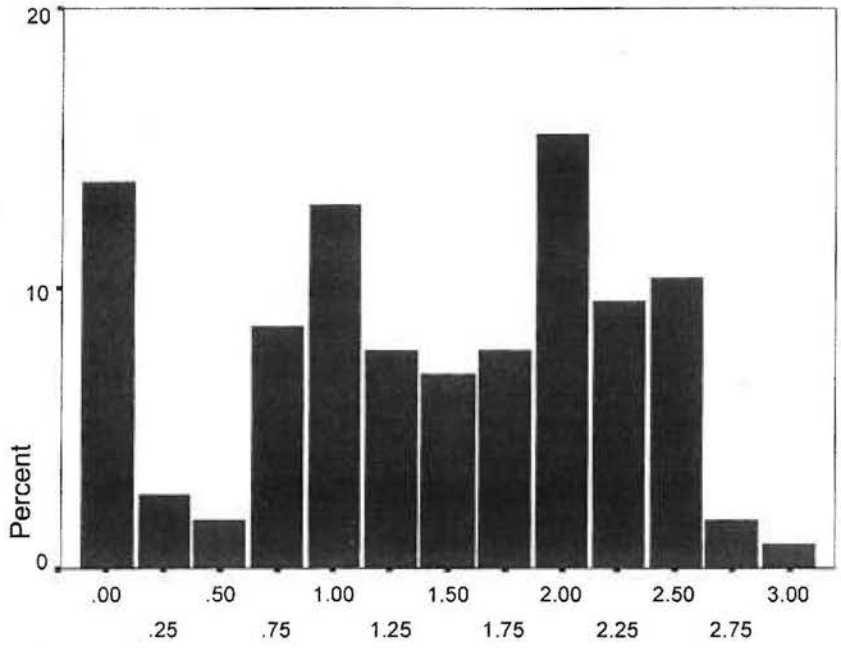

Figure 7.2: Distribution subjective near add powers for Virginia Garcia

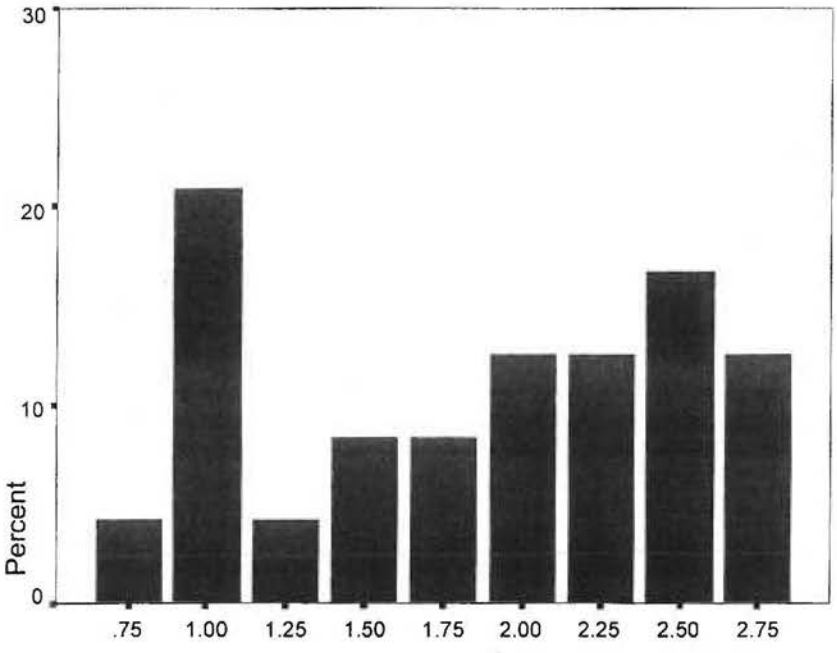

Figure 7.3: Distribution subjective near add powers for Portland

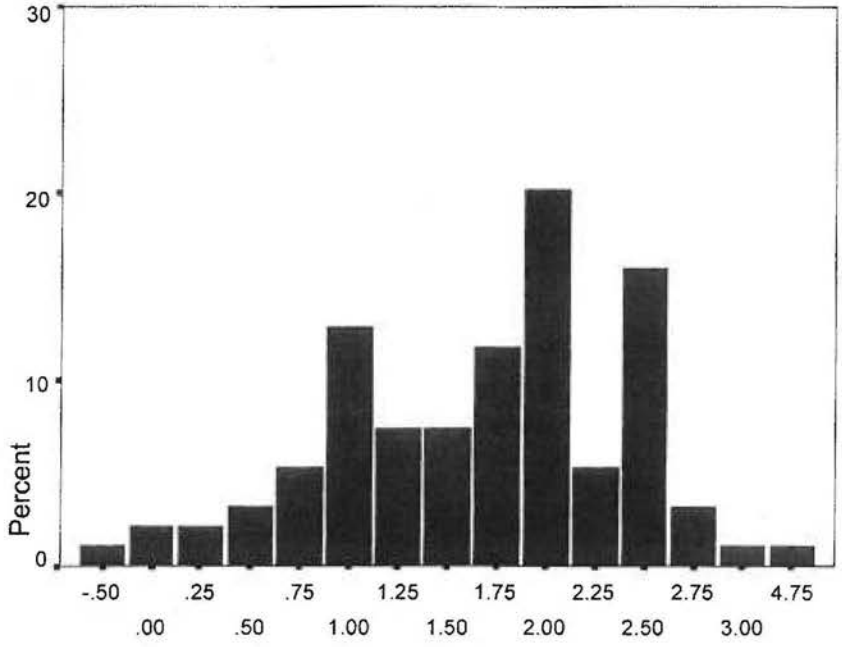

Figure 8.1: Frequency of refractive errors by level of education for Forest Grove

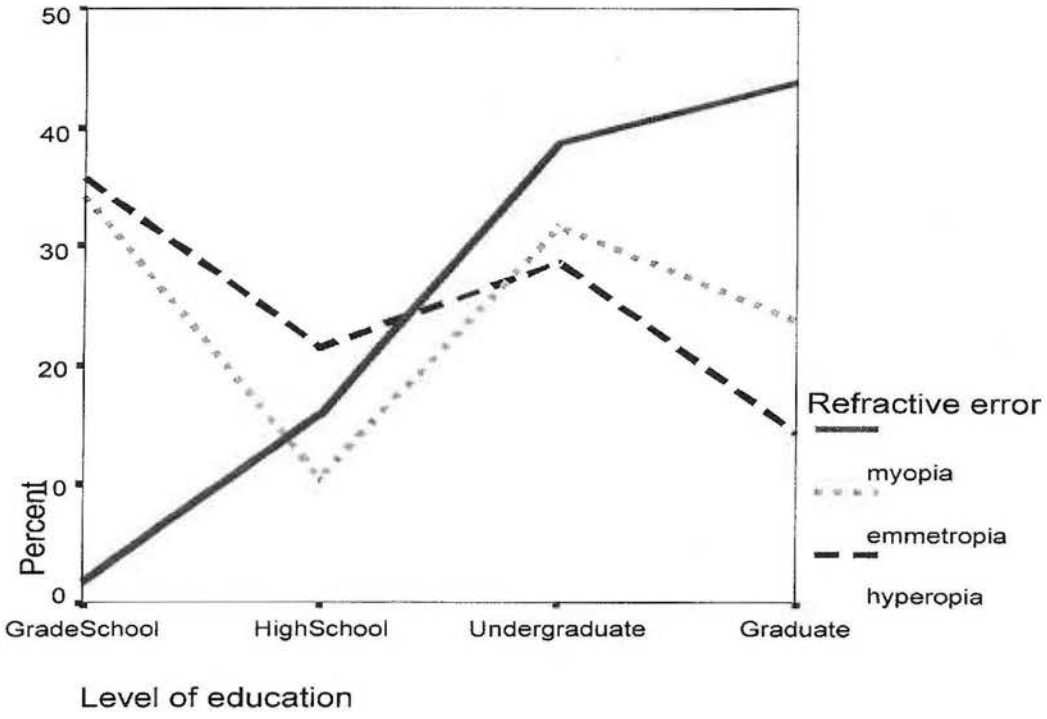

Figure 8.2: Frequency of refractive errors by level of education for Virginia Garcia

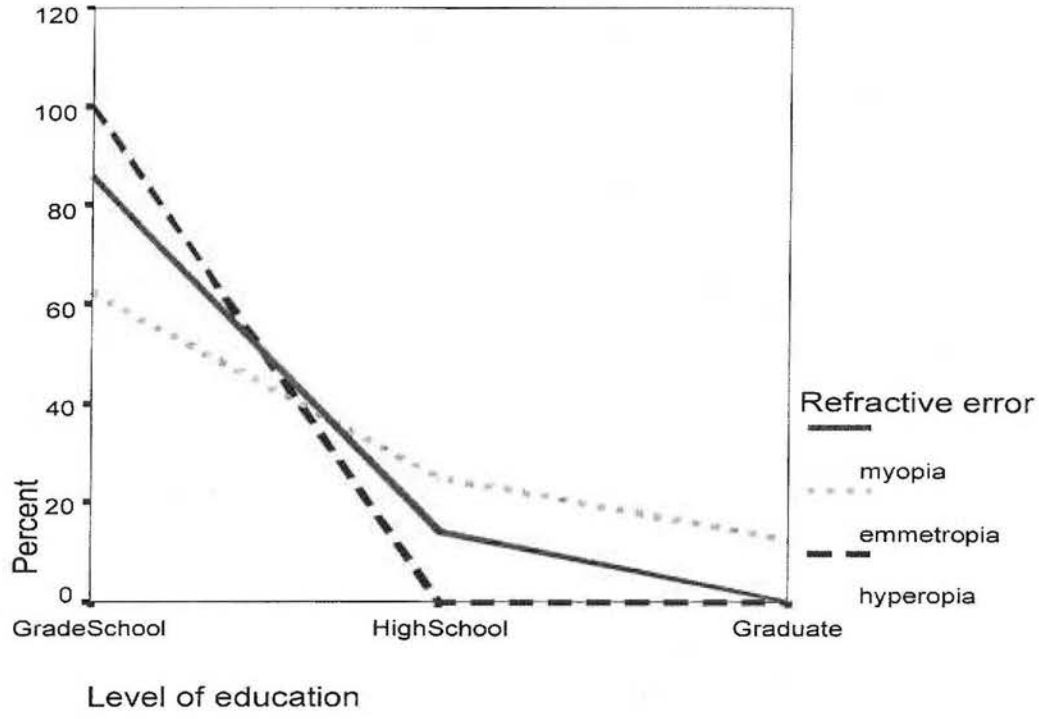

Figure 8.3: Frequency of refractive errors by level of education for Portland

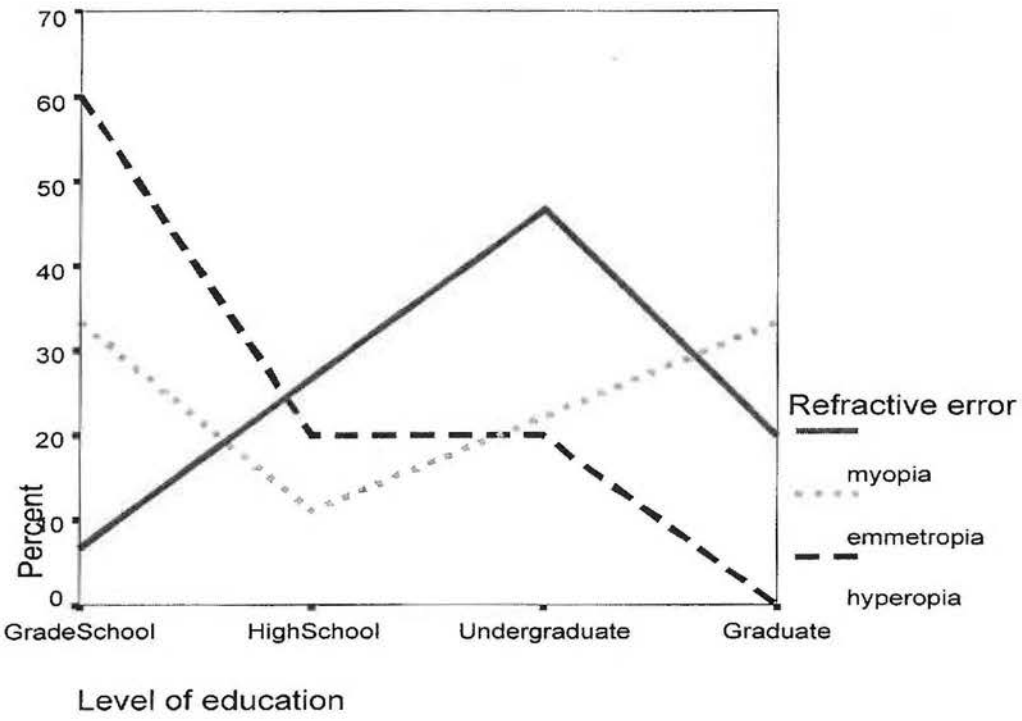

Table 5. Dwaine White classification (based on normative analysis) with and without considering NPC

Dwaine White Classification	Forest Grove				Virginia Garcia				Portland			
	With NPC		Without NPC		With NPC		Without NPC		With NPC		Without NPC	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Normal	52	57.1%	47	51.1%	1	16.7%	1	16.7%	9	42.9%	9	39.1%
Basic eso	6	6.6%	6	6.5%	4	66.7%	4	66.7%	3	14.3%	3	13%
Basic exo	3	3.3%	3	3.3%	0	0%	0	0%	0	0%	0	0%
Divergence insufficient	3	3.3%	3	3.3%	0	0%	0	0%	0	0%	0	0%
Divergence excess	23	25.3%	23	25.0%	0	0%	0	0%	8	38.1%	8	34.8%
Convergence insufficient	0	0%	1	1.1%	0	0%	0	0%	0	0%	0	0%
Convergence excess	4	4.4%	9	9.8%	1	16.7%	1	16.7%	1	4.8%	3	13.0%
Total	91	100%	92	100%	6	100%	6	100%	21	100%	23	100%

DISCUSSION

Pacific University serves the Forest Grove, Cornelius and Portland communities, which, like many other Northwestern US cities, harbor populations from a range of ethnic/racial origins. Part of this study was to obtain descriptive demographics of the patient populations that visit Pacific University optometry clinics. Six hundred five records were reviewed of which only 299 contained ethnic/racial background information. This may be due to the contemporary opinion that race/ethnicity should not be a factor in the quality of care that is provided for patients, and intern doctors may have felt this particular data was not pertinent in patient care; therefore did not record this information or feel comfortable asking their patient this question.

Information gathered on ethnicity and race tells us that Virginia Garcia had an almost exclusively Hispanic patient population (95.4%). The 1990 United States census shows that the area population consists of 5.7% Hispanics [6]. This finding may be explained by the fact that Virginia Garcia Vision clinic is affiliated with the Virginia Garcia medical clinic which caters to a Hispanic population. Another benefit for Hispanics to visit Virginia Garcia clinic is that the receptionist is bilingual and there is a guaranteed translator at visits to help communication.

The study samples randomly taken from the clinics show the percentage of Hispanic population is greater than described by the 1990 Census statistics for the four areas in which most patients defined their address [6]. This may be that proportionally more Hispanic people are attending the University clinics included in this study, perhaps because they give special attention in catering to Hispanics and the costs are less. For example Pacific University does several screenings a year at migrant camps, which are heavily populated by Hispanics and refers those who need care to Virginia Garcia.

In interpreting and analyzing ethical/racial background information there was less information from the other two clinics reviewed. Portland and Forest Grove tend to have more diverse groups than Virginia Garcia and the two additional clinics not reviewed may have even more. Due to a lack of ethnic/racial background information on many of the records reviewed much information was lost. No analysis of prevalence of different disorders in different populations could be made. In addition, the two other clinics, which were not reviewed, serve lower social economic levels, thus limiting generalizations to

these clinics. Continued research in this area would provide valuable information. In the near future, research made at the two additional clinics as well as further review of records at Portland and Forest Grove could be added to better understand the patient demographics of the Portland metropolitan area. Gender differences were also looked at for each clinic. The data shows that the difference in number of female versus male patients is minimal between all three of the clinics.

When reviewing the results on refractive error in the clinics, there are various statistical differences. Portland and Forest Grove clinics have more patients that are myopic than hyperopic or emmetropic, where as in Virginia Garcia more individuals were emmetropic than hyperopic or myopic. Voo's study [7] demonstrates the same finding where myopia prevalence is greater than hyperopia in Hispanic, white, black and Asian population. The difference we see in Virginia Garcia may be due to fact that the population looked at has a younger age distribution, mode being 10 years, while in Forest Grove the mode is 25 and Portland the mode of age is 46 years old. Studies have shown that prevalence of myopia increases as the age of the population increases [8 9 10]. Portland patients also had a greater range of near add than in Forest Grove and Virginia Garcia, though this too could be explained by the fact that the subjects are older in Portland.

As the population ages, we also find a myopic shift in the population, this perhaps is a reflection of an increase in number of years in school seen in the Portland and Forest Grove subjects. This shift has been seen in other studies that look at the education level and prevalence of refractive error [1 11]. The relationship between education and refractive error was not consistent across all three clinics, however. The data is not conclusive in our study because of low numbers. Further analysis of the interaction between myopia, age and education remains to be performed on this population. On the other hand, in the younger population hyperopia is more frequent than myopia, which is seen in all three clinics. This was in accordance with the results of Chen et al [2].

Among the high school population, myopia is more common than hyperopia in the clinics except for Forest Grove. As to proportions, Virginia Garcia had the least amount of astigmatism when compared to the other two clinics and the Portland clinic had the highest number of patients with astigmatism. This may be a characteristic of Hispanic populations in general [9]. This was based on the number of people with astigmatism in the population, not the amount of astigmatism each individual had. When we look at

the range of amount of cylinder in patients, Virginia Garcia had the highest mean amount of astigmatism, as well as the greatest range. Further public health studies should therefore look at developmental factors and lifestyle in Hispanics to determine the reason they have high levels of astigmatism.

Amblyopia is most prevalent in Virginia Garcia and second in Portland and least frequent in Forest Grove. This maybe due to the social economics of the patients seen at the clinics and the availability of corrective measures. This is in keeping with the finding of higher levels of astigmatism discussed above. It should be noted that the prevalence of amblyopia was higher across all three clinics than has been observed in some other western adult or pediatric populations [12]. This suggests that this population would be well served by either offering vision therapy at Virginia Garcia or offering one day a week of Spanish vision therapy in Forest Grove, because of the higher incidence of amblyopia seen in Virginia Garcia which has patient population of 95% Hispanics.

Anisometropia is another ocular measure that can lead to disorders that maybe avoided or treated. The greatest prevalence of anisometropia is observed in Portland with Forest Grove coming in second though it is only slightly greater than Virginia Garcia. This difference in prevalence may be a reflection of the older age distribution for the Portland clinic as has been proposed in other studies [3]. Given that if ansimetropia is not corrected, amblyopia may develop or the patient may become strabismic. This is an important factor that should be verified at each clinical visit and corrected to prevent the onset of these disorders.

Part of our study was to look at why patients came into our clinic and what common symptoms they experienced. Blurred vision was the number one symptom expressed by patients on the intake form in all three clinics. This is a great piece of information for optometrists who practice in specialties that do not involve noticeable blurring of vision. Optometrists may need to educate the population as to other reasons to visit their clinic. This tells us valuable information; the main reason that people decide to come to an optometrist is for blurred vision, however, the population might not know that optometrists have a larger scope of practice and can help with other vision disorders. The next two most frequent symptoms expressed were headaches and irritated eyes in all three clinics. These symptoms suggest that the population recognizes there may be a link between headaches and vision, which could be beneficial for

optometry professionals that are aware that headaches can be prevented by proper prescriptions or through alternative therapies other than lenses.

In Portland, poor night vision and floaters were significantly expressed as concerns on the intake form. Developing a new area of research in night vision prescribing could be beneficial for those patients with difficulties in this area. Furthermore, knowing what the most commonly expressed symptoms of patients, can help optometrists in directing questions more specifically to blurry vision, headaches, night vision difficulties, or irritated eyes.

The remaining symptoms listed on the intake form represented 15% or less of the patients. This proportion, however, is based on completed forms; where 12% of the patients in both Virginia Garcia and Portland did not fill out the intake form or were not asked, almost 27% did not in Forest Grove. In Forest Grove, patients can tend to be friends, spouses or have other connections to the staff and/or interns. The familiarity with staff and or interns or the patient filling the exam form appeared more relaxed and less professional. This non-professional manner may or may not be a detriment to patient care.

Forest Grove had one-third of all patients showing interest in contact lenses at the time of their exam. Research does not provide any reason why Virginia Garcia patients had such a high prevalence of interest in contact lenses, while in Portland the interest was around one in six. Given the apparent unexpected difference in demand for contact lenses, which could potentially change over time for a number of reasons, this statistic would seem to be important for clinics to follow in order to help ensure that staff and supplies are available to meet the demands of the population.

Prevalence of binocular disorders like convergence insufficiency and convergence excess were analyzed by using both Dwain White (DW) classification and OEP norms [13]. It is also important to note that range for pupillary distance for all three clinics was 50-74 mm with no significant differences between the three clinics. This is similar to the observation by Borish who found that the mean interpupillary distance for adults in the general population is 64 mm, and 62 mm for children with a range of 50-60 [14]. Therefore, interpupillary distance should not have been a factor in measuring BI and BO ranges or phorias, and would not have affected the classifications.

In Portland, divergence excess was the most common disorder of DW classification, with convergence excess and basic eso being the second most common disorders. The other classifications

were not found in Portland patient populations. Such calculations, however, entail many measurements where Virginia Garcia only had 6 files that had adequate information to run the analysis; therefore we cannot speculate what the results for Virginia Garcia would mean. In Forest Grove, divergence excess was also the most common, the next common was convergence excess, then basic eso, basic exo, divergence insufficient, and least prevalent was convergence insufficiency. The number of files with enough information in Forest Grove and Portland clinics, however, was also limited (33.08%, 11.5% respectively). Therefore the findings may not be representative of the general population [13 15 16]. Also the age of the patients was not controlled for, so this might be causing our study to show that divergence excess is more prevalent than convergence insufficient or convergence excess [17 18].

When near point of convergence was also considered in judging DW classifications, less problematic patients were found. This may be due to inaccuracy of inexperienced clinicians especially, since the near point of convergence is usually estimated not measured [19]. Also near point of convergence is done in real space whereas the rest of the data in DW classifications is done with a phoropter.

In the Forest Grove, Virginia Garcia and Portland clinics the median distance lateral phoria was ortho. The near phoria's for all three clinics were right around 6 exo, which is clinically the number optometrists focus on as the average of the population. All three of the clinics had approximately the same findings on vergence ranges. Distance BO was greater than distance BI, while near BO was only slightly greater than near BI. All vertical phoria measures averaged to ortho. Positive relative accommodation was highest in Forest Grove, while negative relative accommodation was greatest in Portland. A low mean positive relative accommodation finding in Portland maybe associated with the fact the population in the Portland vision clinic was also older with its mode of 45 years old.

The ICD-9 codes that were used are listed in Figure 4 in the results section. Many of our results have low prevalence in the population and because of low sample record numbers these percentages may not be accurate and representative of the larger population, but some of the statistics are worth mentioning.

Diabetic retinopathy was noted at the Portland clinic with 3% of the patient population there; this is a full percentage above the diabetic retinopathy assessed in the other two clinics. Cataracts were also charted most frequently in Portland patients, then Forest Grove and lastly Virginia Garcia. Both of these

REFERENCES

1. Katz J, Tielsch JM, Sommer A. Prevalence and risk factors for refractive errors in an adult inner city population. Invest Ophthalmol Vis Sci 1997; 38(2):334-40.

2. Chen PC, Chang RJ, Lee DA, Wheeler NC. Prevalence of ocular disorders among 6- and 7-year-olds in Santa Monica, California. J Am Optom Assoc 1996; 67(6):358-65.

3. Bennett GR, Blondin M, Ruskiewicz J. Incidence and prevalence of selected visual conditions. J Am Optom Assoc 1982; 53(8):647-56.

4. Grosvenor T. Primary Care optometry: Anomalies of refraction and binocular vision . 3 edition. Boston: Butterworth-Heinemann, 1996: 35-69.

5. Griffin JR, Grishman JD. Binocular Anomalies: Diagnosis and vision therapy. 3 edition. Boston: Butterworth-Heinemann, 1995: 51, 71.

6. Byerly ER, Deardorff K. National and State Population Estimates: 1990 to 1994, U.S. Bureau of the Census, Current Population Reports, P25-1127. Washington, DC: U.S. Government Printing Office, 1995.

7. Voo I, Lee DA, Oelrich FO. Prevalences of ocular conditions among Hispanic, white, Asian, and black immigrant students examined by the UCLA Mobile Eye Clinic. J Am Optom Assoc 1998; 69(4):255-61.

8. Sperduto RD, Seigel D, Roberts J, Rowland M. Prevalence of myopia in the United States. Arch Ophthalmol 1983; 101(3):405-7.

9. VanNurden ML. Epidemiology of the eye Oregon: Pacific University, 1999.

10. Wingert TA, Harmel LA. Prevalence of vision problems in an indigent urban population. J Am Optom Assoc 1997; 68(5):301-4.

11. Robinson BE. Factors associated with the prevalence of myopia in 6-year-olds. Optom Vis Sci 1999; 76(5):266-71.

12. Thompson JR, Woodruff G, Hiscox FA, Strong N, Minshull C. The incidence and prevalence of amblyopia detected in childhood. Public Health 1991; 105(6):455-62.

13. Rouse MW, Hyman L, Hussein M, Solan H. Frequency of convergence insufficiency in optometry clinic settings. Convergence Insufficiency and Reading Study (CIRS) Group. Optom Vis Sci 1998; 75(2):88-96.

14. Borish WJB. Borish's Clinical Refraction. Philadelphia: WB Saunders Co, 1998: pp. 330.

15. Porcar E, Martinez-Palomera A. Prevalence of general binocular dysfunctions in a population of university students. Optom Vis Sci 1997; 74(2):111-3.

16. Cooper J, Duckman R. Convergence insufficiency: incidence, diagnosis, and treatment. J Am Optom Assoc 1978; 49(6):673-80.

17. Rouse MW, Borsting E, Hyman L *et al.* Frequency of convergence insufficiency among fifth and sixth graders. The Convergence Insufficiency and Reading Study (CIRS) group. Optom Vis

Sci 1999; 76(9):643-9.

18. Scheiman M, Gallaway M, Coulter R *et al.* Prevalence of vision and ocular disease conditions in a clinical pediatric population. J Am Optom Assoc 1996; 67(4):193-202.

19. Schor C. Influence of accommodative and vergence adaptation on binocular motor disorders. Am J Optom Physiol Opt 1988; 65(6):464-75.

20. Robinson B, Acorn CJ, Millar CC, Lyle WM. The prevalence of selected ocular diseases and conditions. Optom Vis Sci 1997; 74(2):79-91.

21. Haffner SM, Fong D, Stern MP *et al.* Diabetic retinopathy in Mexican Americans and non-Hispanic whites. Diabetes 1988; 37(7):878-84.

22. Das BN, Thompson JR, Patel R, Rosenthal AR. The prevalence of eye disease in Leicester: a comparison of adults of Asian and European descent. J R Soc Med 1994; 87(4):219-22.