Refractive Status of Eastern Oklahoma Indian Population

-Bryan S. Karrick
Advisor: Robert L. Carter, O.D.

Abstract

The Native American population in Eastern Oklahoma has a longstanding history of intermarriage with the caucasion population and has acquired a large variance of degree of Indian blood. The objective of the study was to observe the effect of intermarriages upon the unique refractive qualities of the Indian population. The refractive status of 456 eyes was recorded and compiled at Carl Albert Eye Clinc (Indian Health Service) in Ada, Oklahoma. The study exhibits a refractive result closely patterned to a normative population. With-the-rule (WTR) astigmatism and myopia findings however, remained strongly attached to the well-documented traditional Native American refractive characteristics. Further studies are necessary to eliminate some of the ambiguities of this topic.

Introduction

The Carl Albert Indian Hospital is an Indian health service care facility in eastern Oklahoma. The Indian Health Services function to provide a variety of health care services at no cost, to american natives. The service provides health care for individuals that have acquired a Certificate of Degree of Indian Blood (CDIB). The service is provided fully to all individuals regardless of their percentage of Indian blood geneologically. The service is also administered independent of income level. Audiology, dentistry, physical therapy, obstetrics, gynecology, emergency room care, and optometry are provided in addition to primary care medicine, at many facilities.

Eastern Oklahoma gives residency to several nations of Native Americans. Each care facilitiy has an association and a close political connection with a specific tribe. Consequently, a given care facility ascertains a majority of its patient load from the resident nation. However, a native of any tribe may access any Indian facility. Carl Albert Indian Hospital is affiliated with the Chickasaw nations. Other common Carl Albert facilitiy users include; Choctaw, Seminole, Shawnee, and Creek nations.

Eye clinic use by all patients in a timely and reasonable fashion is not possible at Carl Albert facility. The hospital contains 66,000 charts. The average number of complete eye exams given per year by an optometrist is 1,800. As a result, priotities for care were necessary. A stipulation set for Carl Albert Eye Clinic in 1988 allows routine eye examinations for three categories of patients; 1) minors, aged 18 or under, 2) patients that have received routine care prior to 1988 or as a minor, 3) patients diagnosed as diabetic. Other facility patients must use the private sector to obtain visual care. Emergency eye care patients and referrals from within the facility are also treated.

Appointments are made during a one hour period each month, in which the following month's schedule is booked. Appointments made in person are guaranteed, while appointments by phone are discouraged, as there are only two phone lines in the clinic and getting through is difficult. This accomplishes four things; 1) a degree of inconvenience in making an appointment reduces the number of patients scheduled to within an obtainable number, 2) scheduling no farther ahead than one month maintains a low frequency of "no shows", 3) efficiency in scheduling provides more time for patient care, 4) consistent pattern of scheduling offers a platform of fairness to patients making appointments.

Etiology

Why do the refractive errors of Native Americans differ from normative data? Myopia and hyperopia studies indicate that spherical refractive status is a function of heredity. [1,2,3,4,5] Furthermore, differing genetic pools exhibit significant differences in refractive spherical equivalent. [6,7,8,9,10,11] As a result, differences in population refractive data among various races is well known. Indian populations historically have a high prevalence and degree of with-the-rule astigmatism relative to other populations. However, astigmatism has been shown to have no direct genetic correlation. This is best illustrated by Teikari and O'Donnell where the refractive status of monozygotic and dyzygotic twins were recorded. [12] While the spherical components of the monozygotic twins correlated considerably more closely than did those of the dyzygotic twins, there was no greater correlation involved in the comparison of astigmatic errors.

Astigmatism explained by both anatomical and physiological influences would purport that characteristic gene pool differences may have an indirect effect.[13,14] It has been found that with-the-rule corneal toricity was significantly correlated with the degree of Indian blood. Relation of the astigmatism to ocular rigidity, lid tension, and intraocular pressure (IOP) was explored and only IOP was shown to have a significant correlation.[15] This opens the hypothesis that low IOP may allow extraocular muscle tension to influence the sphericity of the globe, but this has yet to be explored. Although Wilson et al. did not show a significant correlation between lid tension and corneal toricity, the premise is popular.

Method

The subjects were patients at Carl Albert Eye Clinic who were given a full refraction. Patients with a history of corneal surgery, keratoconus, pseudophakia, or aphakia are not included in the data base. Refraction was carried out by retinoscopy with subjective refinement. Cycloplegia was used when necessary to contribute information used in final prescription.

The subjects were divided into four refractive states; categories of high and medium hyperopia, low hyperopia, low and medium myopia, and high myopia. The subjects are also categorized according to axis meridian of astigmatism. The groups are; no astigmatism, against-the-rule astigmatism, with-the-rule astigmatism, and oblique astigmatism. The patient age groups are; less than 13 years of age, 13-36 years of age, 37-60 years of age, and greater than 60 years of age.

The spherical component used to quantify the refractive state was measured as the power of the meridian with the least myopia or most hyperopia.

Analysis

As the data population includes a large range of Indian blood backgrounds, comparison to normative groups and Indian populations may be informative. The data arrived at for the patients aged over 60 years aligns closely to the normative data of older individuals. This study found 22.6% of patients over 60 years of age having greater than 1.00 of astigmatism. Lavery, et al. found 25.3% in a population of patients aged 76 years and older.[16]

Laverly, et al. noted 14.6% myopia in their normal elderly population. [17] This study indicated an 18.1% myopia.

Laverly, et al. also noted an against-the-rule astigmatic error of 64.6% and with-the-rule astigmatism of 7.7%.[18] This study aligns closely to those figures with 60.6% and 9.6% respectively. This study's data is deviated slightly toward a with-the-rule astigmatism relative to the norm. This may indicate an Indian population influence on the astigmatism, but is by no means definitive. The table below displays the astigmatic magnitude findings.

	0-1.00	1.25-3.00	> 3.25
< 13	87.5%	9.1%	3.4%
13-36	87.3%	11.3%	1.4%
37-60	80.5%	17.8%	1.7%
> 60	77.4%	22.6%	0

Satterfield indicated a 37.1% prevelance of non-astigmats in a military population with ages ranging 17-54. [19] This study found a similar 32% prevelance in its 13-60 year old population. However, large discrepencies exist between these two data structures: the Indian population showed a larger proportion of with-the-rule error (57.9%) than the normal population (44.7%) when considering the astigmat-only population. Oblique astigmatism prevelance was also greater (12.7% to 8.3%). This positively reflects on the influence of Indian population refractive traits. Conversely, the Indian population showed a lesser magnitude of astigmatism (16.1% > 1.00D). Generally, this population was much less comparable than the Satterfield study (30% > 1.00D) to other Indian studies.

Adler-Grinberg's study of a Sioux population reveals a characteristic prevelance of with-the-rule astigmatism (46.9%) and myopia (66.3%). Approximately 66% of this population lies between the ages of 6 and 40 years. [20] This study found a 29.7% with-the-rule (WTR) proportion and 41% myopia. Maples, et

al., observed a 26% prevelance of 2.00 diopter or greater with-the-rule astigmatic error in grade school Indian children. [21] This conflicts the 41.3% expression of this study's child population. Moreover, the Minnesota Chippewa screening found a 7.6% myopia prevelance (> -.50) while the Oklahoma screening concurred with 7.1% prevelance, opposed to this study's 38.1% (> -.12). The hyperopia presence also concurred on these two screenings with 4.0% and 3.0% (above +1.50D) respectively. This study found a hyperopic status above +2.00D at 15.2%

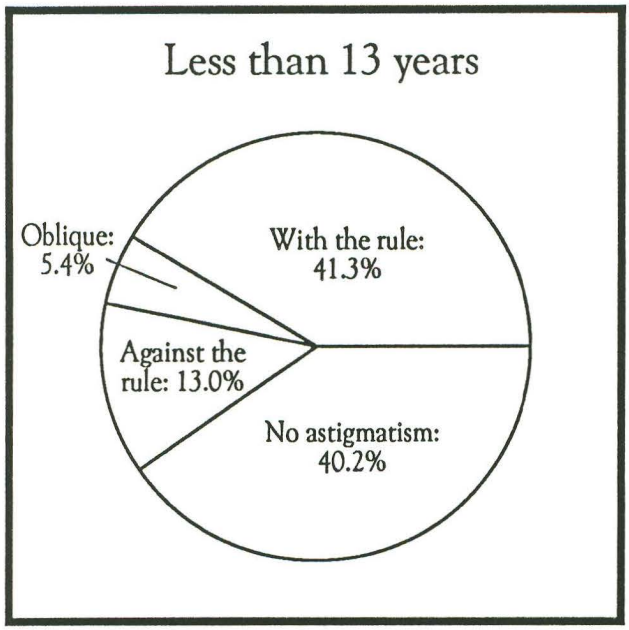
Several influences exist that question the data's value as a true indication of the population's refractive status. These influences are intrinsic to the operation of the Indian Health Service system. Therefore, the population under care in this system is not believed to be representative of the complete Eastern Oklahoman Indian population.

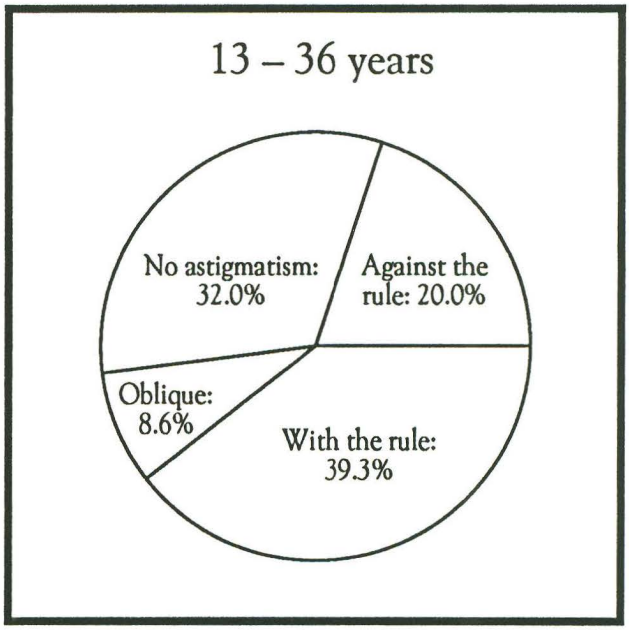
Fulk states that Oklahoma Indians have a long standing history of intermarriage with caucasions. In his study, 14.7% were "full blooded" Indians and 38.2% were less than 1/4 blood. [22] This study was unable to obtain data on the degree of Indian blood of its patient population due to its intrusive nature. Acquiring the information compromises the IHS directive that one is entitled to uncompromised health care in IHS regardless of the indivdual's degree of Indian blood. This is the object of greatest concern in this study. A patient population of varying degrees would be expected to present with refractive status at a point lying between that of "full blood" Indians and normative population, or closely aligned to one or another.

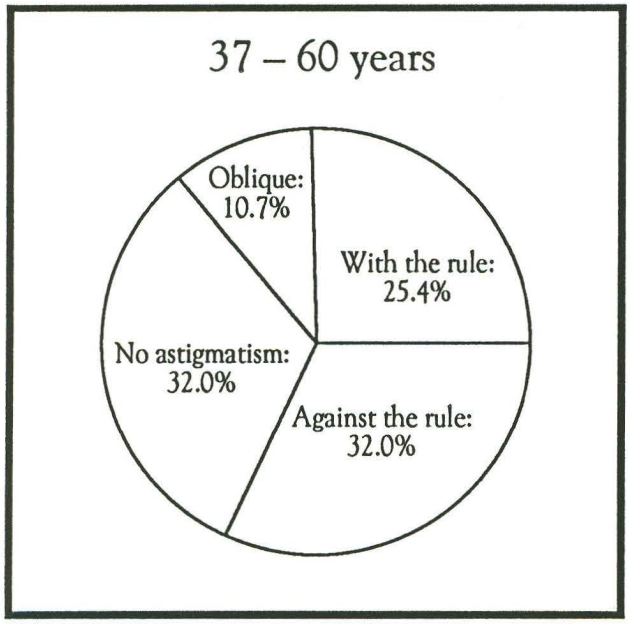
It is probable that the data for this patient population is skewed, considering the parameters of the clinic's scheduling system. Diabetic patients are highly overrepresented in this population. Diabetic refractive changes are purported to increase risk for a permanent myopic shift. [23] This would certainly bias the data associated with the spherical component. Additionally, as refractive changes accompany hyperglycemic level changes, they disagree as to whether myopia or hyperopia accompany an increase or decrease in hyperglycemic status. [24,25,26]

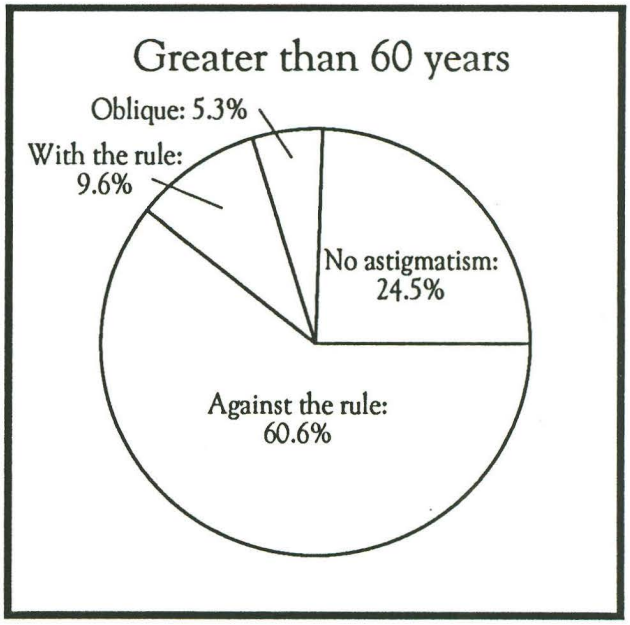
Researchers do agree that the amount of change is usually between one and four diopters. This effect could significantly alter this study's data which was collected without regard to stability of hyperglycemia at time of refraction.

Meridional Analysis of Astigmatism by Age

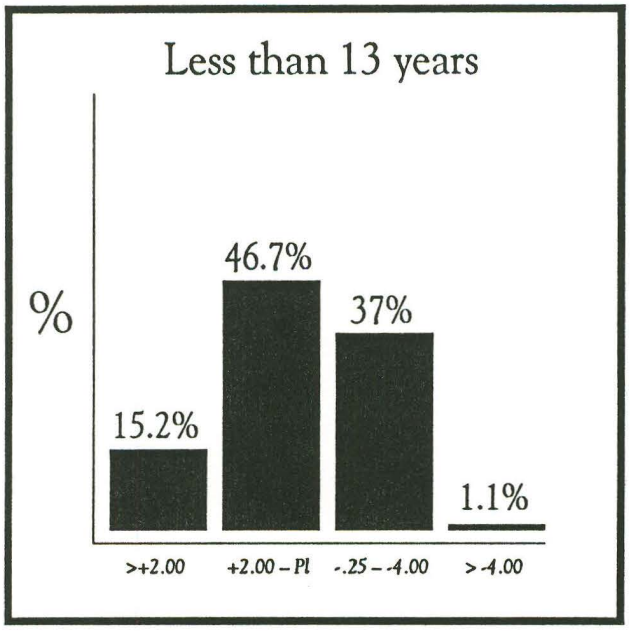


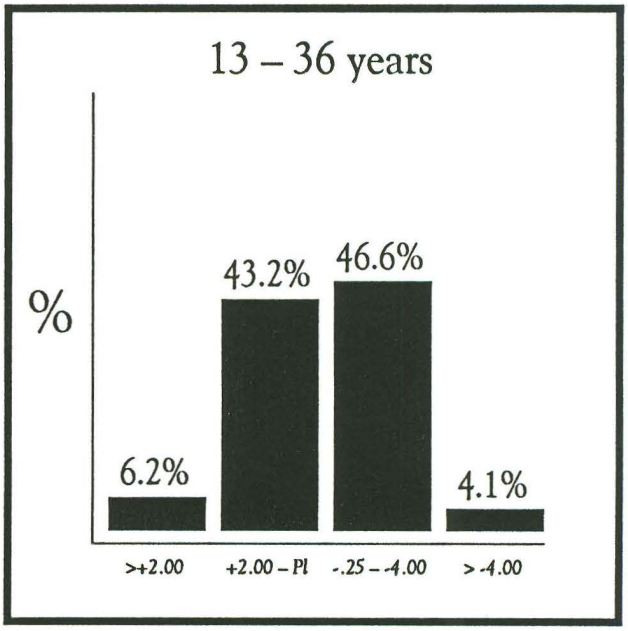


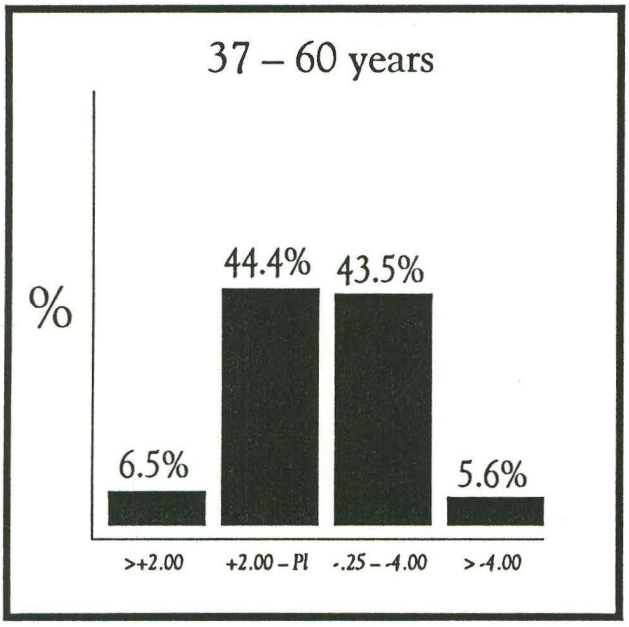


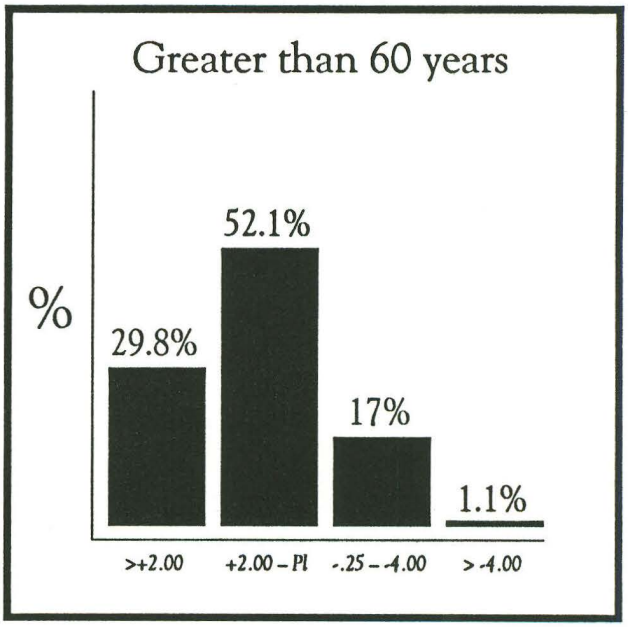


Spherical Component of Refractive Status by Age









Population Findings

Refractive Error

Age	>+2.00	+2.00 – Pl	-.25 – -4.00	> -4.00
<13	15.2%	46.7%	37.0%q	1.1%
13–36	6.2%	43.2%	46.6%	4.1%
37–60	6.5%	44.4%	43.5%	5.6%
>60	29.8%	52.1%	17.0%	1.1%

Meridional Analysis

Age	No Astig.	A.T.R.	Oblique	W.T.R.
<13	40.2%	13.0%	5.4%	41.3%
13–36	32.0%	20.0%	8.6%	39.3%
37–60	32.0%	32.0%	10.7%	25.4%
>60	24.5%	60.6%	5.3%	9.6%

Conclusion

Eastern Oklahoman Indians receiving eye care at the Carl Albert Eye Clinic were refracted and their status compiled. The study is summarized as follows;

1) The population seen at the eye clinic is not a true sampling of the general Eastern Oklahoma Indian population. Indiscriminant use of the clinic is not possible resulting in a patient population altered by criteria inherent to the system.

2) This population exhibits a large range of degree of Indian blood. The results, therefore, are expected to lie somewhere within the parameters of a normal populations refractive state and that of a full blood Indian population's. In overview, the results are seen to align closely to those of the normal population.

3) Although weighted heavily toward the normal population refractive state, this population does demonstrate traditional American Indian refractive characteristics in its high prevalence of with-the-rule astigmatism and myopia.

4) Contrary to other studies of Indian populations, this study did not demonstrate a prevelance of high magnitude astigmatism. This may be an artifact of the population's degree of Indian blood or may indicate a characteristic of the Indian nations involved.

The most ambiguous componet of this data is the degree of Indian blood of the population. A study focusing on one parameter cross-sectioned against more than one population would eliminate the chaotic amount of variability among the present studies. This approach requires a large amount of time as acquiring a population of that specificity belabors the need for a reasonable sample size.

REFERENCES

1. Duke-Elder, S, Abrams D., Ophthalmic Optics and Refraction, Vol V. In Duke-Elder S., ed. System of Ophthalmoscopy, St. Louis, Mosby, 1970:367-72.

2. Fledelius-HC; "Myopia Prevalence in Scandinavia: A Survey with Emphasis on Factors of Relevance for Epidemilogical Refraction Studies in General", Acta- Ophthalmologoica Supplemental Copenhagen. 1988; 185: 44-50.

3. Goss-DA; "Selected Review on Genetic Factors in Myopia", Journal of American Optometric Association, 1988 Nov; 59(11):875-84.

4. Phillips-CI; "Aetiology of Myopia", British Journal of Ophthalmology, 1990 Jan; 74(1); 47-8.

5. Teikari-JM; O'Donnell-J.; Koskenvuo-M, "Impact of Heredity in Myopia", Human Heredity, 1991; 41(3): 151-6.

6. Dib-A, "Distribution of Refractive Errors in Patients from Dominica, West Indies", Journal of American Optometric Association, 1990 Jan 61(1): 40-3.

7. Edwards, M., "The Refractive Status of Hong Kong Chinese Infants", Ophthalmic and Physiological Optics, 1991 Oct; 11(4): 297-303.

8. Garner-LF; Meng-CK; Grosvenor-TP; Mohidin-N, "Ocular Dimensions and Refractive Power in Malay and Melanesian Children", Ophthalmic and Physiological Optics, 1990 Jul; 10(3): 234-8.

9. Hosake- A; "Population Studies--Myopia Experience in Japan", ACTA Ophthalmological Supplemental Copenhagen. 1988; 185: 37-40.

10. Johnson-JG; "Myopia in Arctic Regions; A Survey." ACTA Ophthalmological Supplemental, Copenhagen. 1988; 185: 13-28.

11. Lin-LL; Hung-LF; Shih-YF; Hung-PT; Ko-LS; "Correlation of Optical Componets with Ocular Refraction among Teen-agers in Taipai", Acta- Ophthalmological Suppl-Copenhagen. 1988; 185: 69-73.

12. Teikari-JM; O'Donnell-JJ; "Astigmatism in 72 Twin Pairs", Cornea, 1989 Dec; 8(4); 263-6.

13. Graeme-W; Goss-DA; Vaughan-WA; Roddy-KC; "Corneal Toricity, Lid Tension, Intraocular Pressure, and Ocular Rigidity in North American Indians", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

14. Goss-DA; "Meridional Analysis of With-the-Rule Astigmatism in Oklahoma Indians", Optometric Visual Science, 1989 May;66(5): 281-7.

15. Graeme-W; Goss-DA; Vaughan-WA; Roddy-KC; "Corneal Toricity, Lid Tension, Intraocular Pressure, and Ocular Rigidity in North American Indians", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

16. Lavery-JR; Gibson-JM; Shaw-DE; Rosenthal-AR; " Refraction and Refractive Errors in an Elderly Population.", Ophthalmic and Physiological Optics, 1988 8(4): 394-6.

17. ibid.

18. ibid.

19. Satterfield-DS; "Prevalence and Variation of Astigmatism in a Military Population", Journal of American Optometric Association, 1989 Jan; 60(1): 14-8.

20. Alder-Grinberg D., " Need for Eye and Vison Care in an Underserved Population: Refractive Errors and other Ocular Anomalies in the Sioux", American Journal of Optometry and Physiological Optics, 1986; 63: 553-8.

21. Maples-WC; Atchley-J; Ashby-W; Ficklin-T; "An Epidemiological Study of the Ocular and Visual Profiles of Oklahoma Cherokees and Minnesota Chippewas", Journal of the American Optometric Association, 1990 Oct; 61(10): 784-8.

22. Fulk-GW; "Factors Affecting the Use of an Indian Health Service Clinic", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

23. Fledelius-HC; "Refractive Changes in Diabeties Mellitus Around Onset or When Poorly Controlled. A Clinical Study." ACTA Ophthalmologica Copenhagen 1987; 65: 53-7.

24. ibid.

25. Feinblum, S.M., "Clinical Significance of Refractive Changes in Diabetes", Optometric Weekly, 1972; 63 (9): 199-206.

26. Goss-DA; "Refractive Changes in Diabetics", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

BIBLIOGRAPHY

Alder-Grinberg D., " Need for Eye and Vison Care in an Underserved Population: Refractive Errors and other Ocular Anomalies in the Sioux", American Journal of Optometry and Physiological Optics, 1986; 63: 553-8.

Cook-DT; "Results from Vision Screenings of Northeastern Oklahoma School Children: Refractive Errors", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

Curtin-B; "Topics to be Considered when Establishing Standards for Clinical Myopia Studies",Acta- Ophthalmological Supplemental Copenhagen. 1988; 185: 61-2.

Dib-A, "Distribution of Refractive Errors in Patients from Dominica, West Indies", Journal of American Optometric Association, 1990 Jan 61(1): 40-3.

Duke-Elder, S, Abrams D., Ophthalmic Optics and Refraction, Vol V. In Duke-Elder S., ed. System of Ophthalmoscopy, St. Louis, Mosby, 1970:367-72.

Edwards, M., "The Refractive Status of Hong Kong Chinese Infants", Ophthalmic and Physiological Optics, 1991 Oct; 11(4): 297-303.

Feinblum, S.M., "Clinical Significance of Refractive Changes in Diabetes", Optometric Weekly, 1972; 63 (9): 199-206.

Fledelius-HC; "Myopia Prevalence in Scandinavia: A Survey with Emphasis on Factors of Relevance for Epidemilogical Refraction Studies in General", Acta- Ophthalmologoica Supplemental Copenhagen. 1988; 185: 44-50.

Fledelius-HC; "Refractive Changes in Diabeties Mellitus Around Onset or When Poorly Controlled. A Clinical Study." ACTA Ophthalmologica Copenhagen 1987; 65: 53-7.

Fulk-GW; "Factors Affecting the Use of an Indian Health Service Clinic", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

Garner-LF; Meng-CK; Grosvenor-TP; Mohidin-N, "Ocular Dimensions and Refractive Power in Malay and Melanesian Children", Ophthalmic and Physiological Optics, 1990 Jul; 10(3): 234-8.

Graeme-W; Goss-DA; Vaughan-WA; Roddy-KC; "Corneal Toricity, Lid Tension, Intraocular Pressure, and Ocular Rigidity in North American Indians", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

Goss-DA; "Astigmatism in American Indians", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

Goss-DA; "Meridional Analysis of With-the-Rule Astigmatism in Oklahoma Indians", Optometric Visual Science, 1989 May;66(5): 281-7.

Goss-DA; "Refractive Changes in Diabetics", Eye and Vision Conditions in the American Indians, Goss; Edmundson; ed., Pueblo Publishing Press, Yukon, Oklahoma, 1990.

Goss-DA; "Selected Review on Genetic Factors in Myopia", Journal of American Optometric Association, 1988 Nov; 59(11):875-84.

Hosake- A; "Population Studies--Myopia Experience in Japan", ACTA Ophthalmological Supplemental Copenhagen. 1988; 185: 37-40.

Johnson-JG; "Myopia in Arctic Regions; A Survey." ACTA Ophthalmological Supplemental, Copenhagen. 1988; 185: 13-28.

Lavery-JR; Gibson-JM; Shaw-DE; Rosenthal-AR; " Refraction and Refractive Errors in an Elderly Population.", Ophthalmic and Physiological Optics, 1988 8(4): 394-6.

Lin-LL; Hung-LF; Shih-YF; Hung-PT; Ko-LS; "Correlation of Optical Componets with Ocular Refraction among Teen-agers in Taipai", Acta- Ophthalmological Suppl-Copenhagen. 1988; 185: 69-73.

Maples-WC; Atchley-J; Ashby-W; Ficklin-T; "An Epidemiological Study of the Ocular and Visual Profiles of Oklahoma Cherokees and Minnesota Chippewas", Journal of the American Optometric Association, 1990 Oct; 61(10): 784-8.

Oldenburg-JB; Garbus-J; MCDonnell-JM; McDonnell-PJ; "Conjunctival Pterygia. Mechanism of Corneal Topographic Changes" Cornea 1990 Jul; 9(3): 200-4.

Phillips-CI; "Aetiology of Myopia", British Journal of Ophthalmology, 1990 Jan; 74(1); 47-8.

Satterfield-DS; "Prevalence and Variation of Astigmatism in a Military Population", Journal of American Optometric Association, 1989 Jan; 60(1): 14-8.

Teikari-JM; O'Donnell-JJ; "Astigmatism in 72 Twin Pairs", Cornea, 1989 Dec; 8(4); 263-6.

Teikari-JM; O'Donnell-J.; Koskenvuo-M, "Impact of Heredity in Myopia", Human Heredity, 1991; 41(3): 151-6.