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Recommended Citation

Judson, Darren Hatchard; Matieson, Don; and Summers, Allison, "Prevalence of refractive errors, corneal arcus, and blood pressure readings in 2656 Indonesian subjects" (1996). *College of Optometry*. 1013.
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Prevalence of refractive errors, corneal arcus, and blood pressure readings in 2656 Indonesian subjects

Abstract

On a recent eye care mission to Indonesia, epidemiological information was collected on 2656 indigenous patients. Prevalence of refractive errors, corneal arcus and blood pressure readings were recorded and evaluated. The data from three different sites on the island of Java presented with a definite increased pattern of myopia amongst the youth ages 8 to 19. When compared to other nations, the average refractive error of Indonesians was slightly less hyperopic. Against-the-rule astigmatism had the highest occurrence when compared to other axis orientations, yet the overall occurrence of astigmatism was less than that found in western nations. An elevated prevalence of corneal arcus was discovered in this population. Blood pressure was found to be within normal limits when compared to western clinical standards.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

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Subject Categories

Optometry

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PREVALENCE OF REFRACTIVE ERRORS,
CORNEAL ARCUS, AND BLOOD PRESSURE READINGS
IN 2656 INDONESIAN SUBJECTS

By

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DON MATIESON
ALLISON SUMMERS

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 1996

Adviser:

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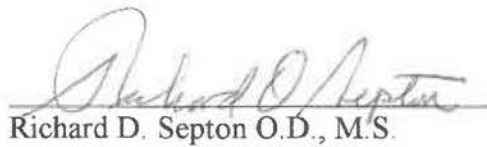
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Current Date: March 4, 1996

BIOGRAPHY OF THE AUTHORS

DARREN JUDSON

I was born in Alberta, Canada, but consider my home to be in the Republic of Singapore. I lived and traveled extensively throughout Asia for approximately 12 years. My undergraduate studies were at University of Central Oklahoma where I was a member of the National Honor Society and received a degree in Visual Science. I plan to graduate from Pacific University College of Optometry May 19, 1996. I also plan to continue indigent eye care internationally and locally while operating a private practice in either Singapore or Grand Forks, British Columbia.

DON MATHIESON

I received a Bachelor of Education degree (with distinction) from the University of Lethbridge in 1991. I am a current member of the Beta Sigma Kappa International Optometric Honor Fraternity and have been involved in Amigos Eye Care in Oregon and on a mission to Mexico. I am from Calgary, Alberta, Canada and will be returning to work there in a group optometrist/ophthalmologist practice working in the co-management of refractive and cataract surgery patients as well as primary care optometry. I would also like to continue to provide volunteer eye care to persons both locally and internationally.

ALLISON SUMMERS

I received my Bachelor of Science degree in Biological Anthropology from the University of California at Davis in 1993. I have been heavily involved in Amigos Eye Care, including eye care missions to Indonesia and Jamaica, and will continue to assist those in need locally and internationally. After graduating from Pacific University College of Optometry in 1998, I plan to teach optometry in Southeast Asia for two years and then return to practice in Oregon.

ABSTRACT

On a recent eye care mission to Indonesia, epidemiological information was collected on 2656 indigenous patients. Prevalence of refractive errors, corneal arcus and blood pressure readings were recorded and evaluated. The data from three different sites on the island of Java presented with a definite increased pattern of myopia amongst the youth ages 8 to 19. When compared to other nations, the average refractive error of Indonesians was slightly less hyperopic. Against-the-rule astigmatism had the highest occurrence when compared to other axis orientations, yet the overall occurrence of astigmatism was less than that found in western nations. An elevated prevalence of corneal arcus was discovered in this population. Blood pressure was found to be within normal limits when compared to western clinical standards.

ACKNOWLEDGEMENTS

We would like to thank James Summers of Visionary Solutions for his invaluable computer expertise and for creating the database which made this paper possible.

We would like to express our gratitude to Amigos Eye Care for its critical role in the collection of this data.

And finally, we would like to acknowledge Dr. Richard Septon for his unwavering support and guidance.

Introduction

On a recent eye care mission to Indonesia, information was collected regarding the prevalence of refractive and ocular health conditions. This epidemiological information can be used by vision care providers interested in serving the Indonesian population. In addition, there is a growing need for research to expand the current level of knowledge regarding visual problems encountered in the populations served. The data contained in this paper was collected during an Amigos Eye Care mission to the island of Java, Indonesia. Amigos Eye Care is a nonprofit student organization which serves the optometric needs of underprivileged communities both locally and internationally.

Background

Indonesia is an archipelago comprising more than 13,000 islands. This nation's population is approximately 198,000,000 with 350 different ethnic and tribal groups speaking over 300 different languages. It is located south of Asia and north west of Australia. While less than 10% of its total land area is suitable for farming, the rest being dense woodlands, forests and swamp, Indonesia is rich in natural resources such as oil, textiles and timber.

Although an independent nation, Indonesia gained its freedom from the Dutch only 70 years ago and is striving to overcome its status as a third world nation^{1,2}. However, it has taken important steps to move itself into the rank of industrialized nations. For example, a program to educate all citizens was started in 1950. While full implementation was not achieved until the early 1980's, a respectable 84.4 % of the population is currently literate¹.

With the assistance of officials from the Marie Stopes Clinics, a private family planning health group, three sites on the island of Java were selected for mobile eye clinics. The first clinic was set up within the local Marie Stopes health care center in Tangerang. This clinic offered free eye care to a poor urban population. The second site was located in a mountainous region of central Java at the city of Bandung. Once again this location was within a Marie Stopes clinic. However, unlike the first, it was away from the severe air, water and land pollution found in Tangerang. The last site was in an open air hospital in the city of Soryeang. This location was in a remote rural area where a large percentage of patients were homemakers and farmers.

Purpose of This Study

Prior to embarking on this mission there was no known western research available to predict the prevalence of refractive errors or ocular conditions for the Indonesian population. Our purpose was to provide epidemiological data to vision care providers both locally and internationally. For example, participants in future missions will be able to select appropriate spectacle corrections from their lens libraries to match the particular refractive conditions of the region. This data will provide future eye care practitioners with vital statistical information not previously accumulated.

Methods

Vision care examinations were conducted at three sites in Indonesia: two urban and one rural. Patients were generally seen on a first-come, first-served basis. Officials from the Marie Stopes health clinic were responsible for registering each subject for a visual exam. The actual visual examinations were performed by a combined group of 20 local opticians, students and professors, 3 local medical

doctors, 20 optometry students from Pacific University, and 3 American optometrists. For purposes of this study, 2656 patients (1635 women, 1021 men) were randomly selected from the more than 4500 subjects who presented themselves for an examination during the period of May 31, 1995 to June 6, 1995.

A typical examination consisted of case history, visual acuity, ophthalmoscopy and autorefraction. If the autorefractor measurements were unobtainable or questionable, a retinoscopy exam was performed. The patients' cases were reviewed after ophthalmoscopy and if further testing was warranted they were sent to the appropriate special testing area. Local opticians and volunteers were responsible for case history, testing distance and near acuities, autorefraction and dispensing eyewear. Additional segments of the exam included: ophthalmoscopy, special testing (e.g. IOP measurement, dilated fundus exam, blood pressure, retinoscopy) and administration of ocular therapeutics. These segments of the exam, along with dispensing of eyewear, were completed by Pacific University optometry students and American optometrists. Decisions for each dispensed prescription were made using the results of autorefraction, any special testing procedures and a subjective evaluation of entrance visual acuities. In addition, if there was a need for presbyopic correction it was prescribed according to a Donders add power table estimation.

Spectacles for the vision care mission were provided by various service clubs (e.g. Lions Club). They were sorted, cleaned, verified, and catalogued according to lens power and gender style by members of Amigos Eye Care at Pacific University. Additional materials used for testing included two Canon autorefractors (one RK-2 and one R-22), Snellen acuity charts (printed English letter and tumbling E's), a Mentor Tonopen and a hand-held Perkins Goldman applanation tonometer.

During the course of visual examinations a remarkable incidence of corneal arcus was noted at all three sites. In an effort to quantify this, the incidence of corneal arcus was recorded for all patients examined on one day at the site in Tangerang.

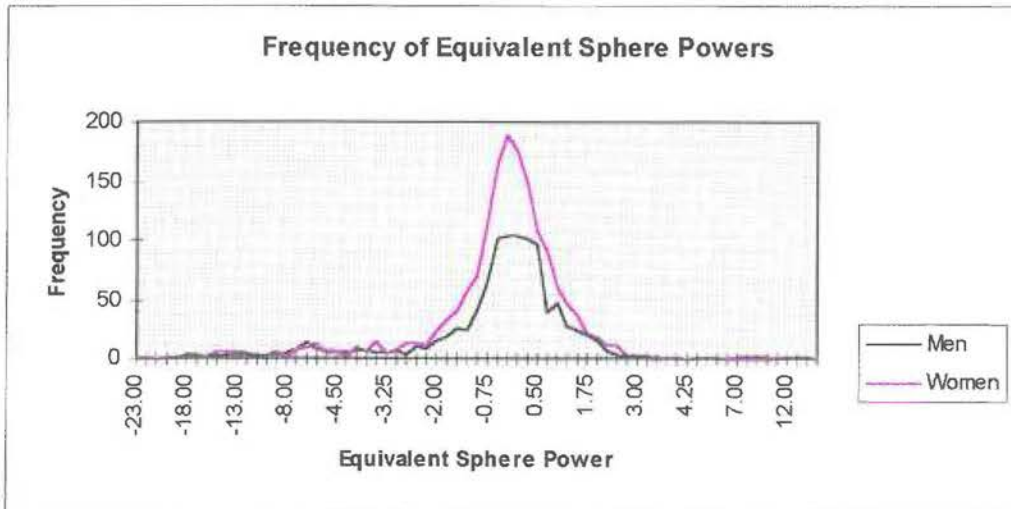


Figure 1a. Comparison of frequency distribution between men and women according to equivalent sphere power. Number of men equals 1021 and number of women equals 1635.

Results

Refractive Data

Refractive data was collected from all 2656 subjects. The frequency of equivalent sphere power for each subject is represented by **figure 1a** and shown in **table 1**. Patients were divided into groups according to gender with 1635 women and 1021 men represented. Equivalent sphere power was defined by using data from patients' right eye autorefractometry or retinoscopy findings. Emmetropia was defined as a right eye spherical equivalent power between -0.25 diopters(D) and +0.50D. The mean equivalent sphere was -0.56D for the women and -0.64D for the men. For both men and women subjects, the majority of refractive errors fell between -2.25D and +2.25D. Out of 2656 patients, 34.7% of the women and 34.4% of the men were considered to be emmetropic. We also calculated the mean equivalent

Table 1. Refractive error distributions for male and female subjects.

Power	Women	Men
-23.00	0	1
-22.00	1	0
-21.00	0	0
-20.00	1	1
-19.00	1	0
-18.00	2	3
-17.00	1	3
-16.00	1	1
-15.00	6	1
-14.00	6	3
-13.00	6	3
-12.00	5	3
-11.00	4	1
-10.00	3	3
-9.00	6	4
-8.00	1	5
-7.00	8	8
-6.00	10	14
-5.00	13	8
-4.75	5	6
-4.50	7	6
-4.25	2	5
-4.00	10	6
-3.75	7	6
-3.50	16	5
-3.25	5	5
-3.00	9	6
-2.75	14	4
-2.50	13	11
-2.25	12	8
-2.00	24	16
-1.75	34	19
-1.50	41	25
-1.25	58	23
-1.00	71	41

Power	Women	Men
-0.75	116	65
-0.50	166	101
-0.25	190	103
0.00	177	103
0.25	150	102
0.50	109	96
0.75	91	39
1.00	61	48
1.25	48	27
1.50	38	24
1.75	22	20
2.00	18	15
2.25	12	6
2.50	12	3
2.75	3	2
3.00	3	2
3.25	3	2
3.50	0	1
3.75	1	0
4.00	1	0
4.25	0	0
4.50	2	1
4.75	1	0
5.00	2	2
6.00	0	0
7.00	0	1
8.00	0	1
9.00	0	2
10.00	0	1
11.00	1	0
12.00	2	0
13.00	2	0
14.00	1	1
15.00	0	0

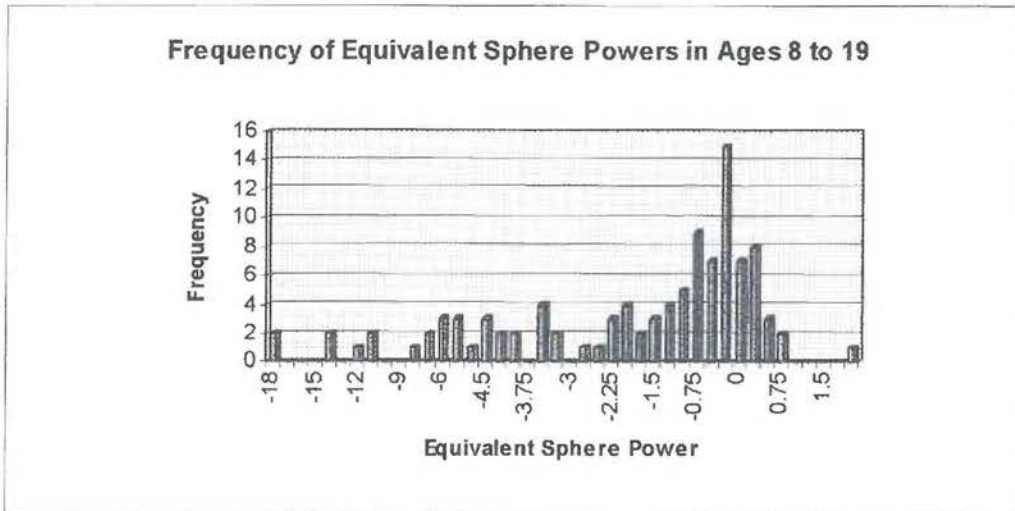


Figure 1b. Frequency distribution histogram of equivalent sphere powers for 105 subjects aged 8 to 19. The mean sphere power was -2.37D.

sphere for 105 subjects between the ages of 8 and 19 years old. The mean was -2.37D; 31.4% of these patients were found to be emmetropic. This is presented in **figure 1b**.

Astigmatism

Out of the 2656 patients selected for our study, 708 subjects had astigmatism in the right eye greater than or equal to 1D. The dioptric range of astigmatism

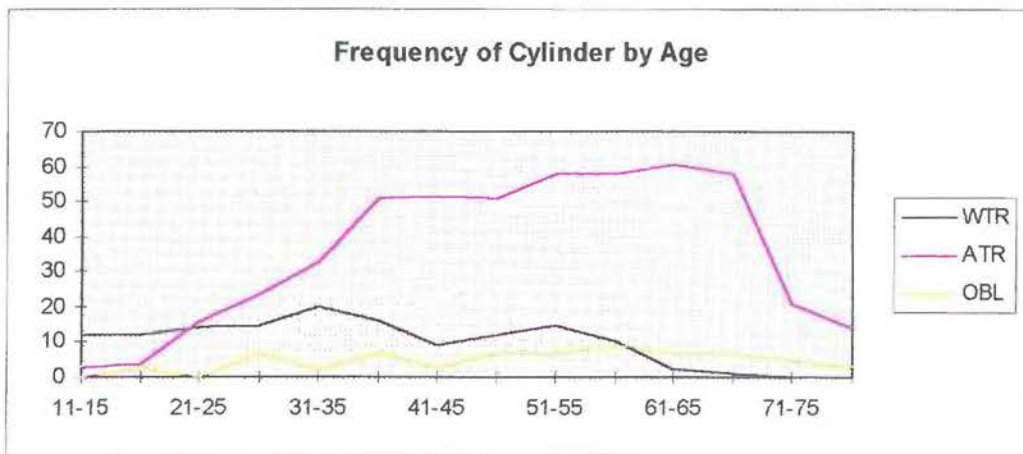


Figure 2a. Frequency distribution of cylinder axis orientation by age. Subjects were defined as having astigmatism if the cylinder power was greater than or equal to -1.00D in the right eye. Number of subjects equals 708.

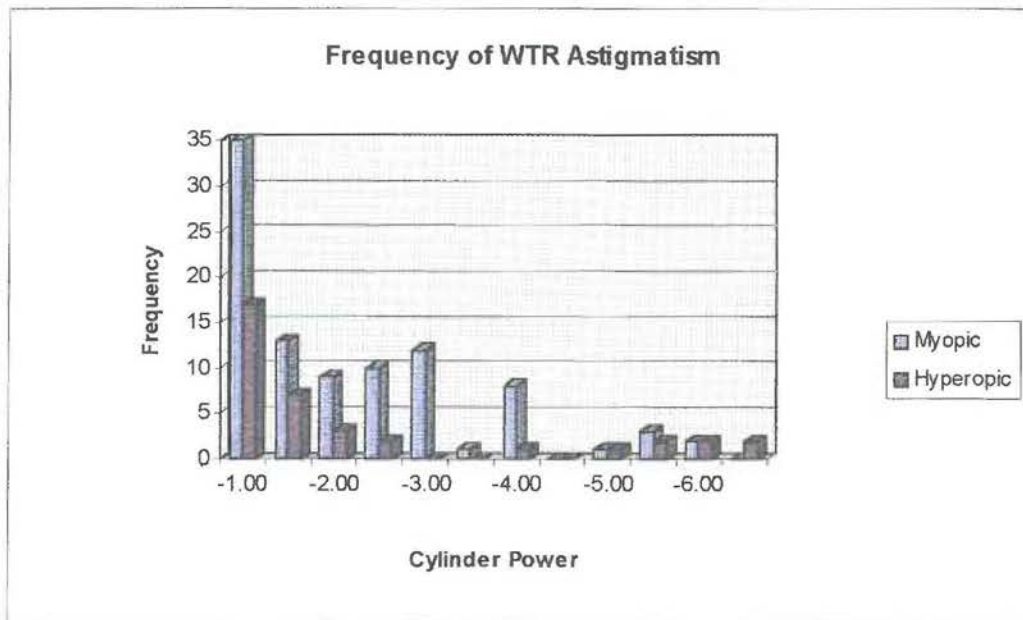


Figure 2b. Comparison of distribution frequency for hyperopic and myopic astigmatic patients having a with-the-rule axis orientation. Number of patients equals 708.

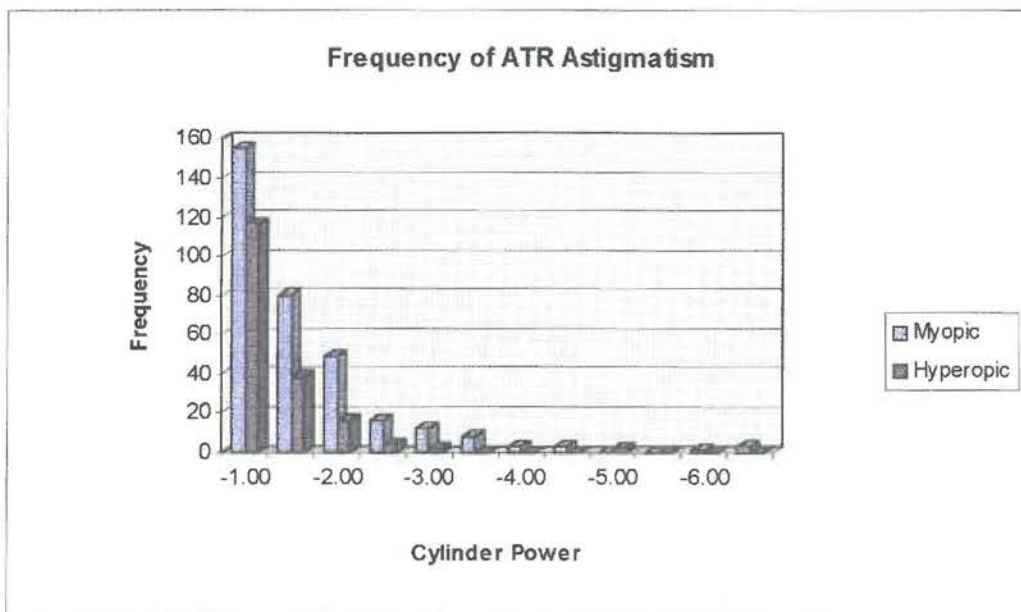


Figure 2c. Comparison of distribution frequency for hyperopic and myopic astigmatic patients having an against-the-rule axis orientation. Number of patients equals 708.

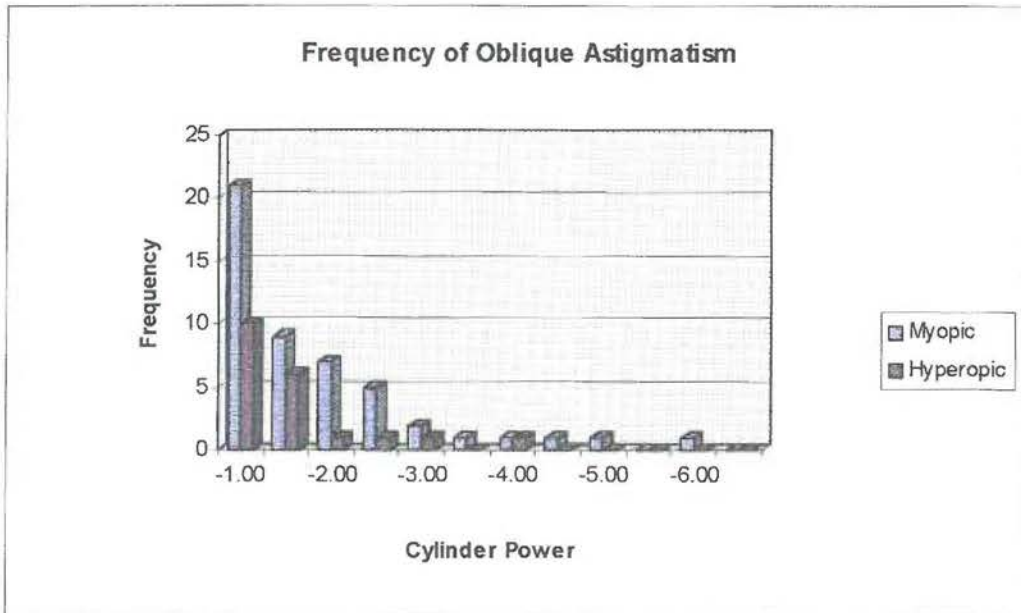


Figure 2d. Comparison of distribution frequency for hyperopic and myopic astigmatic patients having an oblique axis orientation. Number of patients equals 708.

presented was from -1.00 to -6.50D. Distribution of the different correcting cylinder axes according to age can be compared in **figure 2a**. According to our data, 18.5% of patients were given spectacles with the correcting cylinder aligned with-the-rule (axis between 1-30 or 150-180 degrees), 71.8% had an against-the-rule (axis between 60-120 degrees) orientation and 9.7% were aligned with oblique (axis between 31-59 or 121-149 degrees) meridians. The prevalence of with-the-rule, against-the-rule and oblique astigmatic conditions can be seen in figures **2b**, **2c**, **2d**, respectively.

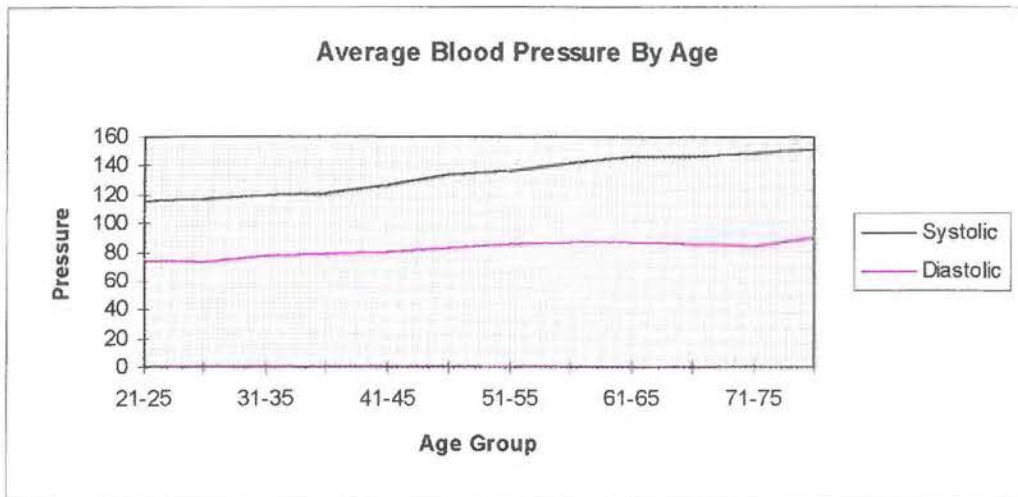


Figure 3. Average blood pressure reading according to age of the subject. Number of patients equals 732.

Blood Pressure

With increasing age, the diastolic and the systolic pressure was found to be elevated. Average blood pressure values for 732 subjects are graphed by age in **figure 3**. The raw data used for the graph is shown in **Table 2**. Ranges were 116 to 152 systole and 76 to 90 diastole.

Table 2. Raw data of systolic and diastolic blood pressure measurements for 732 subjects.

Age Group	Systolic	Std. Dev. +/-	Diastolic	Std. Dev. +/-	Number of Subjects
21-25	116	6	76	5	9
26-30	117	12	74	7	16
31-35	120	18	78	10	32
36-40	121	16	79	12	62
41-45	126	24	81	13	105
46-50	133	23	84	14	105
51-55	136	24	86	13	135
56-60	141	23	88	13	92
61-65	146	26	88	13	72
66-70	146	25	87	17	59
71-75	149	25	85	15	29
76-80	152	36	90	19	16

Corneal Arcus

Out of a sample of 348 patients screened for corneal arcus, 104 women (47%) and 78 men (61%) presented with this condition. The distribution of arcus prevalence for male and female subjects is presented in **figure 4**. When comparing gender results, women 35 years of age or younger had a lower prevalence of arcus than men of the same age. The frequency of arcus for female patients was higher than the male patients from ages 36 to 50 and above the age of 66. One hundred percent of the female subjects 66 years old and beyond had corneal arcus. The greatest percentage of men having corneal arcus was between the ages of 55 to 65.

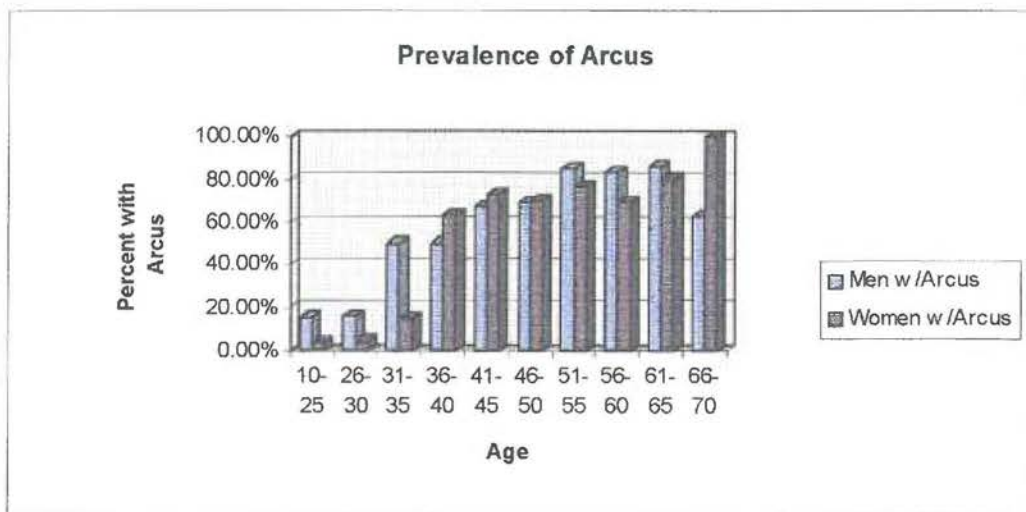


Figure 4. Frequency distribution of arcus prevalence (in %) for patients examined one day at the clinic in Tangerang. Number of men equals 127 and the number of women equals 221.

Discussion

An analysis of our data indicates right eye mean equivalent sphere refractive errors were $-0.56D$ and $-0.64D$ for men and women respectively. This is similar to mean refractive errors found in Finnish subjects³ with secondary or higher education. However, in other studies^{4,5}, the mean refractive error was found to be hyperopia of $+0.67D$ (Nicaragua) and $+0.59D$ for males, $+0.56D$ for females in the East Indian population. The prevalence of myopia for our data indicates 42% of females with

myopia versus 41% of males. Gender comparisons of refractive errors indicate that women show a consistently higher myopia rate in other countries⁶.

As for the subjects between the ages of 8-19, we noticed an increased mean of myopia compared to the population as a whole. In our investigation we found that 65.7% of these subjects were myopic. Myopia rates for similar age groups in other countries were lower: 2.9% Melanesia⁷, 4.5% India⁵, 13.2% Japan⁸, 22.1% China⁸, and 26.0% for Alaskan Inuit⁹. It should be noted that the government of Indonesia implemented mandatory education which was fully realized in 1980¹. Perhaps this mean myopia of -2.37D is due to the recent increase in near demands as Indonesians struggle to free themselves from the stereotype of third world status. This phenomenon has also been reported among native Newfoundlanders¹⁰ and the Alaskan Inuit⁹. Another explanation might be found in the selection process. Our data was collected on patients who were self selected. In this process it is generally the case that patients are more likely to present for an eye exam if they are myopic versus hyperopic. Other investigations^{5,6,7,8} were done on a similar group that was selected by the authors, and therefore, may present more of a random representation of the refractive error for this age group.

Astigmatic subjects in our study showed an increase in against-the-rule axis orientation with increasing age. This is comparable to data found for studies on Finnish³, Fijian¹¹ or South American⁴ subjects. There were 26.7% of our patients who exhibited astigmatism, while there were 10% of patients with astigmatism in Fiji¹¹, 0.3% in Melanesia⁷, 56.2% in Finland³ and 34.0% in Nicaragua⁴. Myopic subjects showed a higher prevalence of astigmatism than emmetropic or hyperopic subjects for all axis orientations and most cylinder power categories. Parssinen³ also found a higher prevalence of astigmatism associated with myopia in his study

of 26 and 46 year old Finns. It is also interesting to note that the prevalence of astigmatism in Indonesia (27% of the population) is less than that seen in the United States (63% of the population)¹² or in the Finnish population (56.2% of the population)³. This finding is even more dramatic when you consider that our patients were self selected.

The increase in incidence of corneal arcus (also known as arcus senilis or lipoides corneae) found at our clinics in Indonesia raised a few questions about its presence there. Corneal arcus is a whitish ring around the peripheral aspect of the cornea. Its etiology is still not completely understood, however it is conjectured that the process is related to increased cholesterol and triglyceride levels¹³. For example, corneal arcus was found 51.4% of the time with atherosclerosis assessed by ultrasonography of the carotid¹⁴. There is also a relationship found with high LDL cholesterol concentration and corneal arcus: "old age and high LDL cholesterol concentration were associated with the presence of corneal arcus"¹. However this is not always the case. In a study of genetic determinants of hyperlipidemia and atherosclerosis, the "frequencies of arcus corneae were not strikingly higher than those found in the general population"². Our data showed an early onset of corneal arcus in young men and greater than 60% presence in women as young as 36-40 years old.

¹ Rouhiainen P, Salonen R, Rouhiainen H, et al. Association of corneal arcus with ultrasonographically assessed arterial wall thickness and serum lipids. *Cornea* 1993 Mar; 12(2):142-5.

² Tybjaerg HA. Rare and common mutations in hyperlipidemia and atherosclerosis. With special reference to familial defective apolipoprotein B-100. *Scand J Clin Lab Invest Suppl* 1995; 220:57-76.

This incidence of arcus elevates our curiosity to the etiology and occurrence in developing nations. Is there a genetic link? In addition, does the elevated level of peanut oils and triglycerides in the local diet play a significant role? Could the severe air and water pollution be a factor? Perhaps all of these are ingredients that constitute the resultant cloudy ring that we commonly refer to as corneal arcus.

A lipid serum and cholesterol analysis of the same population would have been an important finding if we had the resources to initiate such tests. This is an excellent population to be considered for future research in assessing high dietary cholesterol and its relationship to the formation of corneal arcus.

Average blood pressure values were within normal limits in comparison to the American clinical standard of 100 to 140 mmHg systolic and 60 to 90 mmHg diastolic²⁰. This result is surprising considering the abnormal fatty diet secondary to the practice of deep frying foods. However, the American standard might not apply to an Indonesian population.

Conclusion

In summary, the Indonesian population showed a pattern of slightly more myopia than other populations around the world. The youth presented with a pattern of myopia that parallels other developing nations^{9,16}. We found that the prevalence of astigmatism was less than that found in other populations. Of the astigmatic corrections, against-the-rule axis orientation occurred most frequently and the prevalence increased with age. Astigmatic refractive conditions were most often associated with myopia. Corneal arcus was present in 47% of all female subjects and in 61% of all male subjects. Early onset of corneal arcus was more prevalent in young male patients. However, greater than 60% of female patients between 36 and 40 years of age exhibited arcus. This data should prove insightful to future eye care practitioners when examining Indonesian patients and ultimately enhance communication among vision care providers internationally.

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