

# RACE, CULTURE AND MYOPIA IN 110,236 YOUNG SINGAPOREAN MALES

K G Au Eong, T H Tay, M K Lim

## ABSTRACT

*Computerised data of 110,236 Singaporean males aged 15 to 25 (mean 17.75) years who underwent compulsory medical examination from April 1987 to January 1992 was used to estimate the prevalence of myopia among young Chinese, Malay, Indian and Eurasian Singaporean males. The prevalence of myopia amongst the different racial groups was compared after they had been matched for important known confounding factors such as age, sex, educational attainment and degree of urbanization of place of residence. The estimated myopia prevalence was 48.5% in Chinese, 34.7% in Eurasians, 30.4% in Indians and 24.5% in Malays. The overall myopia prevalence rate for all races combined was 44.2%. Within each educational group, the Chinese generally had the highest myopia prevalence whilst the Malays generally had the lowest. Myopia prevalence among the Indians tended to be between that of the Chinese and the Malays. Having matched the various racial groups for age, sex, educational attainment and degree of residential urbanization, it would appear that racial and cultural differences are major influences responsible for the difference in myopia prevalence observed amongst the different races.*

*Keywords: Myopia, race, culture, visual acuity, prevalence.*

SINGAPORE MED J 1993; Vol 34: 29-32

## INTRODUCTION

Myopia is an important cause of impaired vision worldwide. Severe myopia is also an important cause of blindness. It is a serious socio-economic problem<sup>(1)</sup> with multiple ramifications as diverse as manpower deployment in the military services to financial expenses in its optical correction with contact lenses, spectacles and more recently corrective refractive and laser surgery.

Studies on the epidemiology of myopia can be useful in elucidating the possible etiologic mechanisms of myopia. This is important as it can hopefully lead to effective preventive measures to reduce the prevalence and severity of myopia and therefore ease the problems faced by myopes.

Many studies on myopia have been based on select populations such as army recruits<sup>(2-4)</sup>, students eg medical students<sup>(5)</sup>, optometry students<sup>(6)</sup>, and eye clinic patients<sup>(7)</sup>. Myopia prevalence has been found to be closely associated with many factors including age<sup>(1,8)</sup>, sex<sup>(1,4)</sup>, educational attainment<sup>(1,9-11)</sup> and degree of urbanization of place of residence<sup>(1,12)</sup>. These factors make comparison between studies of different select populations difficult. To further study the obviously multiple etiological factors involved in myopia, an attempt to match as closely as possible the abovementioned factors will produce a more revealing picture of the influence of race and culture on myopia.

---

Medical Classification Centre  
Central Manpower Base  
Singapore Armed Forces  
Depot Road Camp  
Depot Road  
Singapore 0410

K G Au Eong, MBBS  
Medical Officer

T H Tay, MBBS, FRCS(Glas), FCOphth(UK)  
Ophthalmologist

M K Lim, MBBS, MSc(OM), MPH  
Chief Medical Officer

**Correspondence to:** Dr K G Au Eong  
Singapore National Eye Centre  
11 Third Hospital Avenue  
Singapore 0316.

---

Singapore's multi-racial population offers an excellent opportunity for such a comparison on myopia prevalence amongst different races and cultures to be done. This paper is a retrospective cross-sectional epidemiological study of myopia in 110,236 young Singaporean males who were examined from April 1987 to January 1992. The prevalence of myopia amongst the Chinese, Malays, Indians and Eurasians was compared after these groups had been matched for age, sex, educational attainment and degree of urbanization of place of residence.

## SUBJECTS AND METHODS

All Singaporean males regardless of their race and culture are called up for a compulsory pre-enlistment medical examination and classification at an appropriate age. There is no screening of any form prior to the medical examination. The vast majority of males are medically examined at 17 to 18 years of age (mean age 17.75 years) although their age may range from 15 to 25 years.

A standardised ophthalmic examination is done for all subjects as part of this medical examination. This includes the determination of monocular unaided distance visual acuity for both eyes using the Snellen's chart.

The computerised data of all subjects who were examined from April 1987 to January 1992 were retrieved and reviewed. However, only the results for the right eye were analysed since refractions for right and left eyes have been found to be highly correlated. All subjects except those with impaired unaided vision which could not be corrected by refraction were included in this study. This made up a total of 110,236 males. This sample represents almost the entire male Singaporean population who were required to report for medical classification from April 1987 to January 1992 and may therefore be considered to be fairly representative of the general population of young Singaporean males 15 to 25 years of age.

As all subjects with impaired unaided vision which could not be corrected by refraction were excluded from this study, the cause of impaired unaided vision of all males in this study is ametropia. Since myopia has an overwhelming preponderance over hyperopia in this age group and in the local context, the estimated prevalence rate of myopia can be taken to be very close to the prevalence rate of ametropia in this study.

Unaided visual acuity of 6/12 or better was considered adequate. Myopes were defined as those with unaided visual acuity of 6/18 or worse in this study.

The major racial groups in Singapore are the Chinese, Malays and Indians. The bulk of the remainder are made up mainly of Eurasians. Each of these racial groups have their own unique culture although they do share some aspects of their way of life (eg diet).

To reduce the number of confounding factors in our comparison between the different racial groups, the groups were matched closely in each of the following factors:

a) *Age*

The prevalence of myopia varies with age<sup>(1,8)</sup>. Myopia is rare among infants of industrialised countries. However, in a birth cohort, it increases in prevalence and severity through the end of adolescence and then stabilizes<sup>(9)</sup>. Although the age range of our sample is from 15 to 25 years, the vast majority of males were examined at 17 to 18 years of age and this small age range minimises any variation in myopia prevalence that may occur due to age variation.

b) *Sex*

Some studies have found females to have a slightly higher myopia prevalence than males<sup>(1,4)</sup>. Since only males are included in this study, gender is not a confounding factor in our analysis.

c) *Educational attainment*

Myopia prevalence is known to be closely associated with educational attainment<sup>(1,9-11)</sup>. To minimise this important confounding factor, the groups for comparison were matched according to their educational level. The highest level of education attained at the time of examination was determined and subjects were classified into one of the following categories in approximately increasing order of educational attainment:

- i) NFE No formal education
- ii) PRI Have begun but not completed 6 to 8 years of primary education
- iii) PSLE Passed the Primary School Leaving Examination ie successfully completed 6 to 8 years of primary education
- iv) SEC Have begun but not completed 4 years of secondary education
- v) GCE'N' Passed the General Certificate of Education 'N' Level Examination ie successfully completed 4 years of secondary education
- vi) GCE'O' Passed the General Certificate of Education 'O' Level Examination ie successfully completed 4 to 5 years of secondary education
- vii) GCE'A' Passed the General Certificate of Education 'A' Level Examination ie successfully completed 2 to 3 years of pre-university education
- viii) DIP Successfully completed a 3-year diploma course
- ix) UNIV Successfully completed 3 to 5 years of university education

d) *Degree of urbanization of place of residence*

Some studies have suggested an association between myopia and the degree of urbanization of place of residence<sup>(1,12)</sup>. The population of Singapore can be considered to be homogenous in this respect since Singapore is a very small country and is almost wholly urbanized.

**RESULTS**

**1) Racial distribution of population**

Of the 110,236 males in our study, there were 88,315 (80.1%) Chinese, 12,854 (11.7%) Malays, and 8,138 (7.4%) Indians (Table I). The bulk of the 929 (0.8%) males of other races were Eurasians.

**Table I – Racial Distribution of Young Singaporean Males**

Race	Number of males	Percentage distribution
Chinese	88,315	80.1%
Malay	12,854	11.7%
Indian	8,138	7.4%
Others	929	0.8%
Total	110,236	100.0%

**2) Estimated prevalence rate of myopia**

The distribution of unaided visual acuity (right eye) of young Singaporean males by race is as shown in Table II. The estimated prevalence rate of myopia in Chinese was the highest amongst the different racial groups (Table III). Almost half (48.5%) of all young Chinese Singaporean males were myopic. Slightly more than one in 3 Eurasians (34.7%) had myopia. Indians had an estimated myopia prevalence rate of 30.4%. Myopia was least common among the Malays (24.5%). The estimated overall prevalence rate of myopia in young Singaporean males of all races was 44.2%.

**Table II – Distribution of Unaided Visual Acuity (Right Eye) among Young Singaporean Males by Race**

		Chinese	Malay	Indian	Others	Total
6/6	Number of males	32,691	7,504	4,405	493	45,093
	Percentage population	37.0	58.4	54.1	53.1	40.9
6/9-6/12	Number of males	12,820	2,206	1,259	114	16,399
	Percentage population	14.5	17.2	15.5	12.3	14.9
6/18-6/24	Number of males	7,671	891	610	70	9,242
	Percentage population	8.7	6.9	7.5	7.5	8.4
6/36-6/60	Number of males	11,422	1,036	717	85	13,260
	Percentage population	12.9	8.0	8.8	9.1	12.0
< 6/60	Number of males	23,711	1,217	1,147	167	26,242
	Percentage population	26.9	9.5	14.1	18.0	23.8
Total	Number of males	88,315	12,854	8,138	929	110,236
	Percentage population	100	100	100	100	100

**Table III – Prevalence of Myopia among Young Singaporean Males (All Educational Groups) by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	88,315	42,804	48.5%
Malay	12,854	3,144	24.5%
Indian	8,138	2,474	30.4%
Others	929	322	34.7%
Total	110,236	48,744	44.2%

If myopia were defined as unaided visual acuity of 6/9 or worse instead of 6/18 or worse in this study, the estimated myopia prevalence rates in the Chinese, Eurasians, Indians, Malays and all races combined would be 63.0%, 46.9%, 45.9%, 41.6% and 59.1% respectively.

As myopia is known to be closely associated with educational attainment<sup>(1,9-11)</sup>, the estimated prevalence of myopia among the different races was compared within the same educational group (Tables IV to XII). The Chinese had consistently the highest estimated prevalence rate of myopia within each educational group except amongst those with no formal education and those with university qualifications. In the first group, the bias towards Eurasians is influenced by the small numbers involved (Table IV) and similarly for the Malays in the latter group (Table XII). The estimated myopia prevalence rate of Malays was generally amongst the lowest compared to that of the other races within the same educational group except in the NFE and PRI groups (Tables IV and V). The rate for Indians tended to be between that for the Chinese and the Malays within each educational group except in the GCE'A' and DIP groups where they were marginally lower than that of the Malays. The number of Eurasians in some of the educational groups was small and this made comparison of their rates difficult.

**Table IV – Prevalence of Myopia among Young Singaporean Males in NFE Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	843	138	16.4%
Malay	116	12	10.3%
Indian	174	26	14.9%
Others	9	2	22.2%
Total	1,142	178	15.6%

**Table V – Prevalence of Myopia among Young Singaporean Males in PRI Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	7,790	1,644	21.1%
Malay	2,194	280	12.8%
Indian	969	148	15.3%
Others	59	6	10.2%
Total	11,012	2,078	18.9%

**Table VI – Prevalence of Myopia among Young Singaporean Males in PSLE Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	6,816	1,449	21.3%
Malay	1,596	193	12.1%
Indian	876	145	16.6%
Others	53	9	17.0%
Total	9,341	1,796	19.2%

**Table VII – Prevalence of Myopia among Young Singaporean Males in SEC Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	5,031	1,437	28.6%
Malay	959	154	16.1%
Indian	652	130	19.9%
Others	74	15	20.3%
Total	6,716	1,736	25.8%

**Table VIII – Prevalence of Myopia among Young Singaporean Males in GCE 'N' Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	4,563	1,596	35.0%
Malay	1,625	341	21.0%
Indian	681	145	21.3%
Others	64	18	28.1%
Total	6,933	2,100	30.3%

**Table IX – Prevalence of Myopia among Young Singaporean Males in GCE 'O' Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	26,523	12,800	48.3%
Malay	4,467	1,288	28.8%
Indian	2,585	863	33.4%
Others	350	110	31.4%
Total	33,925	15,061	44.4%

**Table X – Prevalence of Myopia among Young Singaporean Males in GCE 'A' Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	20,834	14,168	68.0%
Malay	1,311	626	47.7%
Indian	1,709	798	46.7%
Others	236	123	52.1%
Total	24,090	15,715	65.2%

**Table XI – Prevalence of Myopia among Young Singaporean Males in DIP Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	13,471	7,954	59.0%
Malay	565	235	41.6%
Indian	316	131	41.5%
Others	47	22	46.8%
Total	14,399	8,342	57.9%

**Table XII – Prevalence of Myopia among Young Singaporean Males in UNIV Group by Race**

Race	Total no. of males	Myopia	
		No. of males	Prevalence
Chinese	2,444	1,618	66.2%
Malay	21	15	71.4%
Indian	176	88	50.0%
Others	37	17	45.9%
Total	2,678	1,738	64.9%

## DISCUSSION

The estimated prevalence rate of myopia among young Singaporean males was 48.5% in Chinese, 34.7% in Eurasians, 30.4% in Indians and 24.5% in Malays. The overall myopia prevalence rate for all races combined was 44.2%. These rates are higher than those in many published reports of young Caucasian males. Rosner et al<sup>(2)</sup> reviewed the computerised data of 157,748 consecutive Jewish male recruits aged 17 to 19 years and found a myopia prevalence rate of 15.8%. Among British army recruits between 18 and 22 years of age, Sorsby et al<sup>(3)</sup> found an 11% myopia prevalence rate. The prevalence rate of myopia in young Swedish army recruits was reported by Goldschmidt<sup>(4)</sup> as 14.5%. Our study confirms findings from

other studies that Chinese have one of the highest myopia prevalence rates in the world<sup>(13)</sup>. The Eurasians, Indians and Malays in Singapore also have relatively high myopia prevalence rates compared to many Caucasian populations.

The observed differences in the distribution of myopia amongst the different races of young Singaporean males is interesting. Having matched the various racial groups for age, sex, educational attainment and degree of residential urbanization, it would appear that racial and cultural differences are major influences responsible for the difference in myopia prevalence observed amongst the different races.

Race is important in the etiology of disease because it is an expression of genetic constitution<sup>(12)</sup>. It has long been recognised that certain races show strong susceptibility to certain diseases. This appears to be the case for myopia amongst young Singaporean males. This in turn may be due to environmental factors (including culture), genetic constitution or a combination of both.

It is difficult if not impossible to segregate race from culture. Culture, or the learned behaviour of a group, embraces every aspect of the ways of life including diet, clothing, marriage customs, folk medicine, social organisation, religion and superstition<sup>(12)</sup>. Although some areas of culture (eg diet) are being increasingly shared by different racial groups in Singapore, there are still many significant cultural differences among the Chinese, Malays, Indians and Eurasians. How much such differences influence the prevalence of myopia remains to be elucidated. However, since the matched racial groups live in close proximity under many similar conditions (eg climate, housing), a racial or genetic factor may also have contributed to the observed difference in myopia prevalence amongst the different races. In the final analysis, it is likely that a combination of both race and culture influence the prevalence of myopia. How much of the difference in the prevalence of myopia amongst the different races observed is due to racial (genetic) factors and how much is due to cultural differences is, however, still unknown.

## CONCLUSION

The prevalence of myopia in young Singaporean males (44.2%) is among the highest in the world. The estimated myopia prevalence rates are 48.5%, 34.7%, 30.4% and 24.5% among the young Chinese, Eurasian, Indian and Malay Singaporean males respectively. Racial and cultural differences are likely to be major factors responsible for the differences in myopia prevalence observed amongst the different races.

## ACKNOWLEDGEMENTS

We thank Professor Arthur SM Lim, Maj (Dr) Liam Beng Lin and Professor Wallace S Foulds for their advice and support. We are also grateful to Ms Nithia Devan, Ms Tsai Meow Ling and Mr Tan Meng Chye for their assistance and to the past and present staff of the Eye Section, Medical Classification Centre, who performed the eye examinations.

## REFERENCES

1. Curtin BJ. The myopias: Basic science and clinical management. East Washington Square, Philadelphia, Pennsylvania, USA: Harper and Row, 1985.
2. Rosner M, Belkin M. Intelligence, education and myopia in males. Arch Ophthalmol 1987;105(11):1508-11.
3. Sorsby A, Sheridan M, Leary GA. Vision, visual acuity and ocular refraction of young men. Br Med J 1960;1:1394-8.
4. Goldschmidt E. On the etiology of myopia: An epidemiologic study. Acta Ophthalmol 1968;98(suppl):1-172.
5. Chow YC, Dhillon B, Chew PTK, Chew SJ. Refractive errors in Singapore medical students. Singapore Med J 1990;31:472-3.
6. Septon RD. Myopia among optometry students. Am J Optom Physiol Opt 1984;61(12):745-51.
7. Chandran S. Comparative study of refractive errors in West Malaysia. Br J Ophthalmol 1972;56(6):492-5.
8. Slataper FJ. Age norms of refraction and vision. Arch Ophthalmol 1950;43:466-81.
9. Angle J, Wissmann DA. The epidemiology of myopia. Am J Epidemiol 1980;111(2):220-8.
10. Teasdale TW, Fuchs J, Goldschmidt E. Degree of myopia in relation to intelligence and educational level. Lancet 1988;ii(8624):1351-4.
11. Sperduto RD, Seigel D, Roberts J, Rowland M. Prevalence of myopia in the United States. Arch Ophthalmol 1983;101(3):405-7.
12. Mann I. Culture, race, climate and eye disease: An introduction to the study of geographical ophthalmology. Springfield: Charles C Thomas, 1966.
13. Wilson A, Woo G. A review of the prevalence and causes of myopia. Singapore Med J 1989;30:479-84.

# 11th Biennial Asian Congress on Thoracic and Cardiovascular Surgery

*organised by the Malaysian Thoracic and Cardiovascular  
Surgical Association*

*Date: 21 – 25 November 1993  
Venue: Kuala Lumpur, Malaysia*

**For further information, please contact:**

11th BACTCS Secretariat  
Room 3, 5th Floor, MMA House  
124 Jalan Pahang  
53000 Kuala Lumpur  
Malaysia  
Tel: 03-4429662  
Fax: 03-4421618