

# COLOUR VISION IN THE SINGAPORE MALE

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## SYNOPSIS

**27225 Singapore males born in 1962 were assessed for colour vision using the Ishihara Pseudo-isochromatic charts.**

**95.563% were found to have normal colour vision, 4.430% had partial red green defects and only 0.007% were monochromats.**

**Of the main Ethnic groups, the Chinese and Malays had similar incidences of defective colour vision with 4.547% and 4.612% respectively. The Indians however had a significantly lower incidence of 2.676%.**

**Comparisons with incidences in other male population groups are made.**

## INTRODUCTION

All National Service registrants are screened for defective colour vision, commonly called colour blindness, as part of the routine medical examination prior to induction into the Singapore Armed Forces (SAF). Colour vision is important not only for the recognition of military and traffic signals but also to all the arts and crafts which depend on normal colour discrimination, such as the sorting of electric cables, mixing of pigments, colour titration, commouflaging and many others.

There have been no published studies on the incidence of defective colour vision in the Singapore population. It is hoped that this study will be of interest and use in providing an idea of the problem of colour blindness in our male population.

## MATERIALS AND METHODS

The population chosen for study was all the National Service Registrants born in 1962. Since all male Singapore citizens and permanent residents are required to register for National Service at the age of 16 years, the survey effectively covers almost all the male Singaporeans and permanent residents who were born in 1962, less those who were away overseas and those who had failed to register for National Service. The total number screened was 27,225.

No single instrument or test has as yet been proved infallible in the detection of defective colour vision. In our tests, the Ishihara pseudo-isochromatic charts were used because they are one of the most popular and frequently used screening devices for the detection of defective colour vision, besides being simple and easy to use. The

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most important source of error in the use of pseudo-isochromatic charts is a wrong choice of illuminant (Kalmus, 1965)<sup>1</sup>. Chart tests must never be undertaken in direct sunlight nor in rooms with strongly coloured walls, and most importantly never in artificial light unless they meet certain specifications. To eliminate these sources of error our tests were conducted in the verandah of our centre during daylight hours in the shade.

With the Ishihara charts it is possible to detect all the common types of defective colour vision including protan defects (lack of basic red sensation), deutan defects (red and green conceived as same colour sensation) and monochromats (perceiving only vestiges of colour or total colour blindness). However tritan defects (lack of blue sensation) cannot be detected with the Ishihara charts. This particular defect is rare and from studies in England, occurs with a frequency of between 1 in 13,000 to 1 in 65,000 (Wright 1952<sup>2</sup>; Kalmus, 1955<sup>3</sup>). Thus it does not have a significant effect in our study.

The test is carried out by asking each subject to read the numbers in the test charts. If illiterate they are asked to trace the numbers they see with their fingers (but without actually touching and soiling the charts). If a subject is able to read (or trace) all plates correctly he is classified as having normal colour perception. If he is able to read only some of the charts correctly he is classified as being partially colour blind. He is totally colour blind if he can only read the one chart for which no colour discrimination is required, and is unable to read all the other charts.

**FINDINGS**

The results for the whole population under study are shown in the following table:

**TABLE I  
COLOUR PERCEPTION OF THE WHOLE POPULATION**

|                          | Number | Percentage |
|--------------------------|--------|------------|
| Normal Colour Perception | 26,017 | 95.563%    |
| Partial Colour Blindness | 1,206  | 4.430%     |
| Total Colour Blindness   | 2      | 0.007%     |
| Grand Total              | 27,225 | 100.000%   |

The population under study included 20,388 Chinese who made up 74.89% of the population.

For this ethnic group the breakdown in terms of colour perception is as follows:

**TABLE II  
COLOUR PERCEPTION OF CHINESE REGISTRANTS**

|                                       | Number | Percentage |
|---------------------------------------|--------|------------|
| Chinese with Normal Colour Perception | 19,459 | 95.443%    |
| Chinese with Partial Colour Blindness | 927    | 4.547%     |
| Chinese with total colour Blindness   | 2      | 0.010%     |
| Total                                 | 20,388 | 100.000%   |

For the 4,575 Malays who made up 16.81% of the population, the breakdown is as follows:

**TABLE III  
COLOUR PERCEPTION OF MALAY REGISTRANTS**

|                                      | Number | Percentage |
|--------------------------------------|--------|------------|
| Malays with Normal Colour Perception | 4,364  | 95.388%    |
| Malays with Partial Colour Blindness | 211    | 4.612%     |
| Malays with Total Colour Blindness   | 0      | 0          |
| Total                                | 4,575  | 100.000%   |

In the case of the 2,018 Indians making up 7.42% of the population, the breakdown is as follows:

**TABLE IV  
COLOUR PERCEPTION OF INDIAN REGISTRANTS**

|                                       | Number | Percentage |
|---------------------------------------|--------|------------|
| Indians with Normal Colour Perception | 1,964  | 97.324%    |
| Indians with Partial Colour Blindness | 54     | 2.676%     |
| Indians with Total Colour Blindness   | 0      | 0%         |
| Total                                 | 2,018  | 100.000%   |

The "other races" totalled 242 or 0.88% of the population. They include Sikhs, Arabs, Eurasians and other minority ethnic groups. Breakdown according to colour perception is as follows:

**TABLE V  
COLOUR PERCEPTION OF MINORITY ETHNIC GROUPS IN SINGAPORE**

|                          | Number | Percentage |
|--------------------------|--------|------------|
| Normal Colour Perception | 230    | 95.041%    |
| Partial Colour Blindness | 12     | 4.959%     |
| Total Colour Blindness   | 0      | 0          |
| Total                    | 242    | 100.000%   |

Only two Chinese were detected to have total colour blindness and no such cases were detected for the other races. The absence of monochromats in the other races is not statistically significant since the condition is so rare and our population sample is insufficient to indicate its true incidence.

Comparison of the percentage of partial colour blindness amongst the various ethnic groups gives interesting results as follows:

**TABLE VI**  
**OCCURRENCE OF DEFECTIVE COLOUR VISION**  
**AMONGST THE VARIOUS ETHNIC GROUPS**  
**IN SINGAPORE**

|         | Percentage with<br>Partial Colour Blindness |
|---------|---|
| Chinese | 4.547%                                      |
| Malays  | 4.612%                                      |
| Indians | 2.676%                                      |
| Others  | 4.959%                                      |

Whilst the Malays and Chinese seem to have about equal prevalence of partial colour blindness, its occurrence in Indians is substantially less. Studies done elsewhere have shown high frequencies of colour blindness amongst Chinese, Arabs and most European samples, with low frequencies in Negro, and Polynesian samples. North Indians have a higher incidence than Southern Indians.

#### DISCUSSION

In the following table, compiled from Kherumian and Pickford (1959)<sup>4</sup>, Post (1962)<sup>5</sup> and Kalmus et al (1964)<sup>6</sup>, the occurrence of defective colour visions in male populations all over the world are compared:

**TABLE VII**  
**OCCURRENCE OF DEFECTIVE COLOUR VISION IN**  
**MALE POPULATIONS — RANGE OF PERCENTAGE**  
**IN DIFFERENT SAMPLES**

| <u>Europe</u>        | <u>Percent</u> | <u>Asia</u>          | <u>Percent</u> |
|----------------------|----------------|----------------------|----------------|
| English              | 6.8 — 9.5      | Tatars               | 5.0 — 7.2      |
| Scots                | 7.5 — 7.7      | Chinese              | 5.0 — 6.9      |
| French               | 6.6 — 9.0      | Japanese             | 3.5 — 7.4      |
| Belgians             | 7.5 — 8.6      | Indians (Hindus)     | 0. — 10.0      |
| Germans              | 6.6 — 7.8      | Indians (Tribal)     | 0 — 9.0        |
| Swiss                | 8.0 — 9.0      | Israelis             | 2.1 — 6.2      |
| Norwegians           | 8.0 — 10.1     | Filipinas            | 4.3            |
| Czechoslovakians     | 10.5           | Druses (Israel)      | 10.0           |
| Russians             | 6.7            | Fiji Islanders       | 0 — 0.8        |
| Jews (Russian)       | 7.6            | Polynesians (Tonga)  | 7.5            |
| Finns (Leningrad)    | 5.7            | <u>Africa</u>        | <u>Percent</u> |
| Turks (Istanbul)     | 5.1            | Bechaunas            | 3.4            |
| <u>Australia</u>     | <u>Percent</u> | Bugandans            | 1.9            |
| Whites               | 7.3            | Bahutus              | 2.7            |
| Aborogins            | 2.0            | Batutsi              | 2.5            |
| Mixed                | 3.2            | Congolese            | 1.7            |
| <u>North America</u> | <u>Percent</u> | <u>South America</u> | <u>Percent</u> |
| U.S. Whites          | 7.2 — 8.4      | Brazilindians        | 0 — 7.0        |
| U.S. Negroes         | 2.8 — 3.9      | "White" Brazilians   | 6.9 — 7.       |
| Amerindians          | 1.1 — 5.2      | "Dark" Brazilians    | 8.8            |
| Eskimoes             | 2.5 — 6.8      | Brazilian Japanese   | 12.9           |
| Canadian Whites      | 11.2           |                      |                |
| Mexicans (Urban)     | 4.7 — 7.7      |                      |                |
| Mexicans (Tribal)    | 0 — 2.3        |                      |                |

Different techniques used may be responsible for different percentages in the same population. Accurate comparisons cannot therefore be made between the various studies.

Our local percentage of 4.4% colour blind persons would mean that about 1 in 23 persons are partially colour blind in that they confuse the colours red and green. Certain shades of colour or shade differences will escape them particularly when it comes to the perception of red (or brown) colours and their distinction from greens. Though such persons are disqualified from certain vocations in the SAF, their condition does not necessarily handicap them if they are placed in vocations where colour discrimination is not important.

Paradoxically they may also have an advantage in certain situations. It has been noticed during wartime that colour blind observers were sometimes less effectively deceived by camouflage than were observers having normal colour vision (Kalmus)<sup>1</sup>. The explanation of this curious fact is that the pigments used when imitating such objects as grass or soil are not the natural ones, and that the colour of the materials and the artificial objects are

balanced for the "colour — normal" eye but not for the abnormal eye. But of course when it comes to camouflaging himself against "colour — normal" eyes, a colour blind person is at a distinct disadvantage.

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