INCIDENCE RATES FOR MICROSCOPICALLY DIAGNOSED CANCER IN THE SINGAPORE POPULATION 1960-1964

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There is a dearth of reliable cancer incidence data from Asia. Many Asian countries can provide relative frequency data, namely the proportion of a given cancer site in all cancers. But, at the time of writing, incidence levels, that is the number of new cases of cancer appearing in a population of known size and age-sex composition in a defined period of time, have been published only for Israel, Bombay (India) and certain Japanese Prefectures (UICC: 1966, 1970). Comprehensive cancer registration began in Singapore with the establishment of the Singapore Cancer Registry in 1968. The incidence levels of selected cancers are available (Shanmugaratnam, 1971) and it is expected that the full results of cancer registration will soon be published.

This paper is based on the records of the Singapore Institute of Pathology which has maintained, since 1948, a register of all histologically diagnosed cancer cases. It presents crude and age standardised incidence rates for microscopically diagnosed cancers in Singapore during the period 1960-64. These rates, which constitute *minimum* incidence rates, are given for the population as a whole and for each of the major ethnic groups. Attention is drawn to some interesting racial group differences. The purpose of this communication is to provide a background against which the results of comprehensive cancer registration and changes in cancer patterns may be assessed.

Minimum Incidence Rates: The incidence rates presented in this paper are derived by dividing the numerator, i.e. the number of microscopically diagnosed cases of cancer (both at biopsy and/or necropsy) occurring in the Singapore population in 1960-1964 by the denominator, i.e. the number of persons alive in that population during that time, and multiplying the resulting figure by 100,000 . The results are then expressed as so many cancers per 100,000 per annum.

Unless all persons with cancer have the diagnosis made either by biopsy or at necropsy—a most unlikely event—an incidence rate based on microscopically diagnosed cancers cannot be the "true" rate. Nevertheless, the true level of cancer cannot be less than the rate so obtained if patients are counted once only and if cases resident outside the registration area are excluded. The incidence rates for microscopically diagnosed cancer could thus be described as "minimum" incidence rates.

To examine the effect of age on cancer incidence it is customary to compute age-specific rates, generally for 5-year age intervals, for each cancer site and for each sex, by dividing the number of person with cancer in that 5-year age-group by the number of persons alive in that age-group during the period in question. By virtue of censuses held in 1947 (del Tufo, 1949) and 1957 (Chua, 1964) it has been possible to calculate appropriate populations-at-risk and hence age-specific minimum incidence rates.

Valuable and interesting though age-specific minimum incidence rates are, it is often rather difficult to compare series of such figures and a synoptic or summary figure expressing the minimum incidence rate for all ages combined is of great assistance. One such summary rate is the crude rate—the total number of cancers divided by the total population-at-risk expressed per 100,000 per annum. But, as the age-specific rates for cancer generally increase with age, the age structure of the population can have a profound effect on the crude rate. Hence, unless the populations being compared have an identical age-structure, crude rates are of little use and a form of standardization to allow for the effects of differences in population age-structures is needed. In Singapore this is particularly necessary as the racial groups which comprise the population have rather different population pyramids, Indians and Pakistanis in particular having considerable excess of males in the older age-groups (Chua,1964).

Age-Standardized Rates: In this paper an age-standardized rate has been computed by applying the age-specific rates for the various five-year age-groups to a hypothetical "World" population

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(UICC, 1966). This population is based on a population computed by Segi (1960) to represent the average of the age-distributions in 46 countries throughout the world. The resultant age-standardized rates are given, together with the crude rates, in Tables I (All Races), and II (Chinese, Malays, Indians and Pakistanis, Other Races). [For further details of the methodology of age-standardization see Lilienfeld, Pedersen and Dowd (1967)].

The use of this population enables the reader to compare the Singapore minimum incidence rates with the incidence rates for other countries found in the UICC Monographs "Cancer Incidence in Five Continents" (UICC: 1966, 1970) and the various racial groups with each other. This convenient device cannot, of course, transform the minimum rate, based on microscopic diagnoses, into a "true" rate based on all modes of diagnosis. Further, in making comparison between Singapore and other countries with comprehensive cancer registration, it must be remembered that if the Singapore minimum rate is higher than that observed elsewhere, then the difference is real in the sense that as the "true" Singapore rate can only be higher than the minimum the actual difference between the rates can only be greater. Much greater caution is required if the Singapore minimum incidence rate is lower than that elsewhere as the true difference will be less, and may therefore be artefactual.

METHODS AND MATERIALS

For this paper we have confined ourselves to an examination of the 6,624 histologically confirmed cancers seen in 6,613 persons in 1960-1964.

The Numerator

Virtually all cancers in the civil populace of Singapore which are diagnosed microscopically have that diagnosis made in the Institute of Pathology. All such cases—biopsy or necropsy—are filed alphabetically on index cards by name, and again alphabetically by individual cancer site according to the 7th Revision of the ICD, i.e. the International Statistical Classification of Diseases, Injuries and Causes of Death (WHO, 1957). These cards were rigorously examined to ensure that a given patient who may have had several biopsies, all showing cancer, and who may have subsequently come to necropsy, was counted only once.

The sole pathologist in private practice kindly granted access to his records. Specimens referred from countries outside Singapore were excluded, as were specimens from transients such as seamen. Material from the expatriate military population in Singapore, who did not appear in the Singapore censuses, was also excluded. In other words, to the best of our knowledge, only genuine Singapore residents were included in the study.

The Denominator

A series of populations-at-risk were calculated by sex for each five-year age-group from 0-4 to 70+ by arithmetic extrapolation from the 1947 and 1957 census figures. These comprise the denominators for the calculation of the age-specific and hence the age-standardized minimum incidence rates.

RESULTS

All Races

The total numbers and the crude and age-standardized minimum incidence rates for all cancer sites for the Singapore population for 1960-1964 are given in Table I for both sexes and all persons.

There is a considerable male excess of cancer patients in the ratio of 1·34:1, a difference which is accentuated after age-adjustment the ratio then becoming 1·44:1. These findings are due to an excess of males in the population (1·09:1) and to the male excess of cancer for virtually all sites other than the female genital tract and breast. Further, the cancers occurring in women are those associated with middle rather than old age, and hence age-adjustment has a greater effect on the male rates.

The Commonest Cancers: Perusal of the number of cases in Table I shows that the five most frequent *histologically* confirmed cancers are:

	Males	Females
1.	Nasopharynx	Cervix uteri
2.	Stomach	Breast
3.	Lung	Nasopharynx
4.	Liver	Stomach
5.	Oesophagus	Lung

However, when the rates are age-adjusted, the rank order for males changes considerably, as shown below:

	Males	Females
1.	Stomach	Cervix uteri
2.	Lung	Breast
3.	Nasopharynx	Nasopharynx
4.	Oesophagus	Stomach
5.	Liver	Lung

TABLE I

SINGAPORE 1960 - 1964

MICROSCOPICALLY DIAGNOSED CANCER—TOTAL NUMBERS
CRUDE RATES (CR) AND AGE-STANDARDIZED RATES (ASR) BY SITE AND SEX

ICD 7th Revision	Site	Males			Females			Both Sexes		
		Nos.	CR	ASR	Nos.	CR	ASR	Nos.	CR	ASR
140	Lip	5	0·1	0·3	2	0·0	0·1	7	0·1	0·2
141	Tongue	60	1·3	2·9	20	0·5	0·7	80	0·9	1·7
142	Salivary gland	7	0·2	0·2	15	0·4	0·6	22	0·3	0·4
143-4	Mouth	75	1·7	3·7	28	0·7	1·2	103	1·2	2·3
146	Nasopharynx	465	10·4	14·9	210	5·1	7·8	675	7·9	11·6
145-7-8	Other pharynx	92	2·1	4·7	20	0·5	0·8	112	1·3	2·6
150	Oesophagus	296	6·6	14·5	67	1·6	3·0	363	4·3	8·4
151	Stomach	464	10·4	20·4	167	4·1	6·9	631	7·4	13·4
152	Small intestine	2	0·0	0·1	3	0·1	0·1	5	0·1	0·1
153	Colon	116	2·6	5·3	69	1·7	3·0	185	2·2	4·0
154	Rectum	176	4·0	8·2	125	3·1	5·6	301	3·5	6·8
155.0	Liver, primary	331	7·4	12·2	55	1·3	2·2	386	4·5	7·3
155.1	Gallbladder etc.	28	0·6	1·3	21	0·5	1·0	49	0·6	1·1
156	Liver, secondary	58	1·3	2·3	24	0·6	1·1	82	1·0	1·7
157	Pancreas	26	0·6	1·3	14	0·3	0·6	40	0·5	0·9
160	Nose, sinuses etc.	46	1·0	2·0	21	0·5	0·9	67	0·8	1·4
161	Larynx	132	3.0	6·6	8	0·2	0·4	140	1·6	3·3
162-3	Bronchus, Trachea	411	9·2	19·8	140	3·4	6·2	551	6·5	12·6
170	Breast	7	0·2	0·2	334	8·2	12·9	341	4·0	6·3
171	Cervix uteri	—	—	—	625	15·3	24·5	—	—	—
172	Corpus uteri	—	—	—	115	2·8	4·8	—	—	—
173	Malignant trophoblastic disease	—	—	—	51	1·2	1·5	—	—	—
175	Ovary etc.	—	—	—	122	3·0	4·6	—	—	—
176	Other fem. genital	—	—	—	20	0·5	0·8	—	—	—
177	Prostate	34	0·8	3·0	—	—	—	—	—	—
178	Testis	32	0·7	0·8	—	—	—	—	—	—
179.0	Penis	59	1·3	2·5	—	—	—	—	—	—
180	Kidney	22	0·5	0·9	24	0·6	0·8	46	0·5	0·8
181.0	Bladder	100	2·2	5·7	28	0·7	1·4	128	1·5	3·3
190	Melanoma, skin	15	0·3	0·7	8	0·2	0·3	23	0·3	0·5
191	Other skin	153	3·4	7·4	99	2·4	4·8	252	3·0	6·2
192	Eye	16	0·4	0·3	5	0·1	0·1	21	0·2	0·2
193	Brain, nerv. syst.	57	1·3	1·4	36	0·9	0·8	93	1·1	1·1
194	Thyroid	16	0·4	0·6	43	1·1	1·5	59	0·7	1·0
195	Other endocrine	3	0·1	0·2	1	0·0	0·0	4	0·0	0·1
196	Bone	21	0·5	0·5	14	0·3	0·4	35	0·4	0·5
197	Connective tissue	27	0·6	1·1	23	0·6	0·8	50	0·6	0·9
198-9	Sec. and unspecified	277	6·2	11·4	186	4·6	7·7	463	5·4	9·4
200	Lymphosarcoma	68	1·5	2·2	39	1·0	1·4	107	1·3	1·8
201	Hodgkin's disease	31	0·7	0·9	9	0·2	0·2	40	0·5	0·6
202	Other reticuloses	4	0·1	0·1	4	0·1	0·1	8	0·1	0·1
203	Multiple myeloma	6	0·1	0·2	1	0·0	0·0	7	0·1	0·1
204	Leukaemia	52	1·2	1·3	27	0·7	0·7	79	0·9	1·0
	Multiple cancers	4	0·1	0·3	7	0·2	0·3	11	0·1	0·3
140-205	All Sites	3,794	85·2	162·7	2,830	69·3	112·8	6,624	77·6	134·4

TABLE II

SINGAPORE 1960 - 1964

MICROSCOPICALLY DIAGNOSED CANCER—TOTAL NUMBERS
CRUDE RATES (CR) AND AGE-STANDARDIZED RATES (ASR) BY SITE AND SEX

CHINESE

ICD 7th Revision	Site	Males			Females		
		Nos.	CR	ASR	Nos.	CR	ASR
140	Lip	4	0·1	0·4	1	0·0	0·1
141	Tongue	32	1·0	2·4	13	0·4	0·6
142	Salivary gland	4	0·1	0·2	14	0·4	0·6
143-4	Mouth	37	1·2	2·9	15	0·5	0·8
146	Nasopharynx	442	13·8	20·2	202	6·4	9·0
145-7-8	Other pharynx	59	1·8	3·9	15	0·5	0·7
150	Oesophagus	273	8·5	17·2	58	1·8	3·1
151	Stomach	412	12·8	24·6	158	5·0	7·7
152	Small intestine	2	0·1	0·2	2	0·1	0·1
153	Colon	99	3·1	6·1	67	2·1	3·4
154	Rectum	151	4·7	9·3	115	3·6	6·0
155.0	Liver, primary	299	9·3	14·9	51	1·6	2·4
155.1	Gallbladder etc.	18	0·6	1·1	19	0·6	1·0
156	Liver, secondary	50	1·6	2·7	22	0·7	1·1
157	Pancreas	20	0·6	1·1	14	0·4	0·7
160	Nose, sinuses etc.	36	1·1	2·0	19	0·6	1·0
161	Larynx	104	3·2	6·9	7	0·2	0·4
162-3	Bronchus, trachea	379	11·8	23·6	134	4·2	6·9
170	Breast	4	0·1	0·2	280	8·8	12·9
171	Cervix uteri	—	—	—	542	17·1	25·2
172	Corpus uteri	—	—	—	103	3·2	5·0
173	Malignant trophoblastic disease	—	—	—	37	1·2	1·4
175	Ovary etc.	—	—	—	101	3·2	4·6
176	Other fem. genital	—	—	—	17	0·5	0·8
177	Prostate	25	0·8	3·0	—	—	—
178	Testis	25	0·8	0·9	—	—	—
179.0	Penis	37	1·2	2·2	—	—	—
180	Kidney	17	0·5	1·0	21	0·7	0·9
181.0	Bladder	75	2·3	5·8	25	0·8	1·5
190	Melanoma, skin	10	0·3	0·7	8	0·3	0·4
191	Other skin	106	3·3	4·7	82	2·6	4·9
192	Eye	12	0·4	0·3	4	0·1	0·1
193	Brain, nerv. syst.	43	1·3	1·4	32	1·0	0·9
194	Thyroid	12	0·4	0·6	34	1·1	1·4
195	Other endocrine	3	0·1	0·2	1	0·0	0·0
196	Bone	19	0·6	0·7	10	0·3	0·4
197	Connective tissue	21	0·7	1·2	19	0·6	0·7
198-9	Sec. and unspecified	234	7·3	12·8	162	5·1	7·9
200	Lymphosarcoma	42	1·3	1·8	34	1·1	1·4
201	Hodgkin's disease	20	0·6	0·9	6	0·2	0·2
202-5	Other reticuloses	3	0·1	0·1	4	0·1	0·1
203	Multiple myeloma	3	0·1	0·2	1	0·0	0·0
204	Leukaemia	45	1·4	1·5	25	0·8	0·8
	Multiple cancers	4	0·1	0·3	7	0·2	0·3
140-205	All Sites	3,181	99·0	182·8	2,481	78·2	117·7

TABLE II (Continued)

SINGAPORE 1960 - 1964

MICROSCOPICALLY DIAGNOSED CANCER—TOTAL NUMBERS
CRUDE RATES (CR) AND AGE-STANDARDIZED RATES (ASR) BY SITE AND SEX

MALAYS

ICD 7th Revision	Site	Males			Females		
		Nos.	CR	ASR	Nos.	CR	ASR
140	Lip	—	—	—	1	0·2	0·5
141	Tongue	6	1·0	2·4	2	0·3	0·7
142	Salivary gland	3	0·1	0·6	1	0·2	0·2
143-4	Mouth	1	0·2	0·9	2	0·3	1·1
146	Nasopharynx	20	3·2	5·8	5	0·9	2·0
145-7-8	Other pharynx	5	0·8	3·5	3	0·5	1·4
150	Oesophagus	3	0·5	1·3	3	0·5	1·0
151	Stomach	8	1·3	2·7	1	0·2	0·5
152	Small intestine	—	—	—	—	—	—
153	Colon	3	0·5	1·4	1	0·2	0·5
154	Rectum	10	1·6	4·4	4	0·7	1·6
155.0	Liver, primary	13	2·1	4·5	4	0·7	0·8
155.1	Gallbladder etc.	2	0·3	0·7	—	—	—
156	Liver, secondary	2	0·3	0·6	2	0·3	1·0
157	Pancreas	1	0·2	0·1	—	—	—
160	Nose, sinuses etc.	5	0·8	2·3	2	0·3	0·5
161	Larynx	4	0·6	1·6	—	—	—
162-3	Bronchus, trachea	16	2·6	6·4	2	0·3	1·4
170	Breast	2	0·3	1·0	29	5·0	10·8
171	Cervix uteri	—	—	—	41	7·1	14·6
172	Corpus uteri	—	—	—	8	1·4	3·7
173	Malignant trophoblastic disease	—	—	—	12	2·1	2·5
175	Ovary etc.	—	—	—	11	1·9	3·8
176	Other fem. genital	—	—	—	—	—	—
177	Prostate	3	0·5	1·9	—	—	—
178	Testis	5	0·8	1·0	—	—	—
179.0	Penis	4	0·6	0·8	—	—	—
180	Kidney	3	0·5	0·5	1	0·2	0·5
181.0	Bladder	6	1·0	3·0	2	0·3	1·5
190	Melanoma, skin	1	0·2	0·4	—	—	—
191	Other skin	10	1·6	3·0	8	1·4	3·4
192	Eye	1	0·2	0·1	1	0·2	0·1
193	Brain, nerv. syst.	3	0·5	0·3	—	—	—
194	Thyroid	—	—	—	6	1·0	1·7
195	Other endocrine	—	—	—	—	—	—
196	Bone	1	0·2	0·2	3	0·5	0·6
197	Connective tissue	3	0·5	1·5	1	0·2	0·2
198-9	Sec. and unspecified	18	2·9	8·2	17	3·0	7·5
200	Lymphosarcoma	10	1·6	2·5	2	0·3	1·0
201	Hodgkin's disease	2	0·3	0·5	1	0·2	0·2
202-5	Other reticuloses	—	—	—	—	—	—
203	Multiple myeloma	—	—	—	—	—	—
204	Leukaemia	4	0·6	0·4	1	0·2	0·2
	Multiple cancers	—	—	—	—	—	—
140-205	All Sites	178	28·7	64·6	177	30·7	65·2

TABLE II (Continued)

SINGAPORE 1960 - 1964

MICROSCOPICALLY DIAGNOSED CANCER—TOTAL NUMBERS
CRUDE RATES (CR) AND AGE-STANDARDIZED RATES (ASR) BY SITE AND SEX

INDIANS AND PAKISTANIS

ICD 7th Revision	Site	Males			Females		
		Nos.	CR	ASR	Nos.	CR	ASR
140	Lip	1	0·2	0·1	—	—	—
141	Tongue	21	4·0	8·8	4	1·6	4·0
142	Salivary gland	—	—	—	—	—	—
143-4	Mouth	37	7·1	12·7	11	4·5	14·1
146	Nasopharynx	2	0·4	0·2	—	—	—
145-7-8	Other pharynx	27	5·2	15·6	2	0·8	3·1
150	Oesophagus	18	3·5	10·0	6	2·5	9·4
151	Stomach	38	7·3	11·1	6	2·5	5·6
152	Small intestine	—	—	—	1	0·4	0·4
153	Colon	10	1·9	1·7	—	—	—
154	Rectum	12	2·3	5·8	3	1·2	6·8
155.0	Liver, primary	19	3·7	7·9	—	—	—
155.1	Gallbladder etc.	6	1·2	5·1	2	0·8	7·0
156	Liver, secondary	6	1·2	3·6	—	—	—
157	Pancreas	4	0·8	4·1	—	—	—
160	Nose, sinuses etc.	5	1·0	2·7	—	—	—
161	Larynx	23	4·4	9·8	1	0·4	1·5
162-3	Bronchus, trachea	13	2·5	6·3	3	1·2	4·7
170	Breast	1	0·2	0·1	8	3·3	10·0
171	Cervix uteri	—	—	—	32	13·1	46·8
172	Corpus uteri	—	—	—	—	—	—
173	Malignant trophoblastic disease	—	—	—	1	0·4	0·3
175	Ovary etc.	—	—	—	5	2·0	5·5
176	Other fem. genital	—	—	—	2	0·8	6·1
177	Prostate	5	1·0	3·8	—	—	—
178	Testis	—	—	—	—	—	—
179.0	Penis	18	3·5	6·9	—	—	—
180	Kidney	1	0·2	0·2	2	0·8	1·0
181.0	Bladder	16	3·1	9·8	1	0·4	1·2
190	Melanoma, skin	2	0·4	0·8	—	—	—
191	Other skin	17	3·3	7·4	2	0·8	3·9
192	Eye	2	0·4	0·4	—	—	—
193	Brain, nerv. syst.	10	1·9	1·7	4	1·6	1·4
194	Thyroid	4	0·8	1·3	1	0·4	0·4
195	Other endocrine	—	—	—	—	—	—
196	Bone	1	0·2	0·2	1	0·4	0·5
197	Connective tissue	2	0·4	0·2	2	0·8	7·6
198-9	Sec. and unspecified	19	3·7	5·4	5	2·0	5·6
200	Lymphosarcoma	14	2·7	4·0	3	1·2	4·5
201	Hodgkin's disease	8	1·5	1·9	1	0·4	0·5
202-5	Other reticuloses	1	0·2	0·2	—	—	—
203	Multiple myeloma	2	0·4	0·4	—	—	—
204	Leukaemia	3	0·6	0·4	—	—	—
	Multiple cancer	—	—	—	—	—	—
140-205	All Sites	368	71·0	147·4	109	44·6	151·8

TABLE II (Continued)

SINGAPORE 1960 - 1964

MICROSCOPICALLY DIAGNOSED CANCER—TOTAL NUMBERS
CRUDE RATES (CR) AND AGE-STANDARDIZED RATES (ASR) BY SITE AND SEX

OTHER RACES

ICD 7th Revision	Site	Males			Females		
		Nos.	CR	ASR	Nos.	CR	ASR
140	Lip	—	—	—	—	—	—
141	Tongue	1	1·0	1·0	1	1·1	1·4
142	Salivary gland	—	—	—	—	—	—
143-4	Mouth	—	—	—	—	—	—
146	Nasopharynx	1	1·0	1·2	3	3·3	3·7
145-7-8	Other pharynx	1	1·0	1·2	—	—	—
150	Oesophagus	2	2·0	3·0	—	—	—
151	Stomach	6	6·0	8·1	2	2·2	3·5
152	Small intestine	—	—	—	—	—	—
153	Colon	4	4·0	5·2	1	1·1	0·9
154	Rectum	3	3·0	5·5	3	3·3	4·4
155.0	Liver, primary	—	—	—	—	—	—
155.1	Gallbladder etc.	2	2·0	1·9	—	—	—
156	Liver, secondary	—	—	—	—	—	—
157	Pancreas	1	1·0	3·0	—	—	—
160	Nose, sinuses, etc.	—	—	—	—	—	—
161	Larynx	1	1·0	2·5	—	—	—
162-3	Bronchus, trachea	3	3·0	7·6	1	1·1	2·2
170	Breast	—	—	—	17	18·5	24·1
171	Cervix uteri	—	—	—	10	10·9	17·3
172	Corpus uteri	—	—	—	4	4·3	7·8
173	Malignant trophoblastic disease	—	—	—	1	1·1	0·9
175	Ovary etc.	—	—	—	5	5·4	7·2
176	Other fem. genital	—	—	—	1	1·1	2·2
177	Prostate	1	1·0	3·0	—	—	—
178	Testis	2	2·0	1·9	—	—	—
179.0	Penis	—	—	—	—	—	—
180	Kidney	1	1·0	2·5	—	—	—
181.0	Bladder	3	3·0	2·0	—	—	—
190	Melanoma, skin	2	2·0	2·3	—	—	—
191	Other skin	20	19·9	28·2	7	7·6	8·1
192	Eye	1	1·0	0·8	—	—	—
193	Brain, nerv. syst.	1	1·0	0·9	—	—	—
194	Thyroid	—	—	—	2	2·2	3·7
195	Other endocrine	—	—	—	—	—	—
196	Bone	—	—	—	—	—	—
197	Connective tissue	1	1·0	1·6	1	1·1	0·9
198-9	Sec. and unspecified	6	6·0	9·5	2	2·2	2·1
200	Lymphosarcoma	2	2·0	5·5	—	—	—
201	Hodgkin's disease	1	1·0	0·7	1	1·1	1·6
202-5	Other reticuloses	—	—	—	—	—	—
203	Multiple myeloma	1	1·0	1·0	—	—	—
204	Leukaemia	—	—	—	1	1·1	1·6
	Multiple cancers	—	—	—	—	—	—
140-205	All Sites	67	66·8	100·0	63	68·4	93·7

Incidence by Ethnic Group

As Chinese form 75% of the Singapore population, the figures in Table I represent for the most part cancers in Chinese and thus overwhelm any ethnic group differences that may exist. Table II thus presents data for the major ethnic groups in Singapore, namely Chinese, Malays, Indians and Pakistanis and Other Races. The five most frequent neoplasms in each ethnic group are listed in Table III (Other Races excepted).

TABLE III

SINGAPORE 1960-1964
MICROSCOPICALLY DIAGNOSED CANCER AGE-STANDARDIZED RATES OF FIVE COMMONEST CANCERS BY SEX AND ETHNIC GROUP

Rank	CHINESE			
	Males		Females	
1	Stomach	24·6	Cervix uteri	25·2
2	Lung	23·6	Breast	12·9
3	Nasopharynx	20·2	Nasopharynx	9·0
4	Oesophagus	17·2	Stomach	7·7
5	Liver	14·9	Lung	6·9

Rank	MALAYS			
	Males		Females	
1	Lung	6·4	Cervix uteri	14·6
2	Nasopharynx	5·8	Breast	10·8
3	Liver	4·5	Ovary	3·8
4	Rectum	4·4	*	—
5	*	—	*	—

Rank	INDIANS & PAKISTANIS			
	Males		Females	
1	Oro-hypo-pharynx	15·6	Cervix uteri	46·8
2	Mouth†	12·7	Mouth†	14·1
3	Stomach	11·1	Breast	10·0
4	Oesophagus	10·0	Oesophagus	9·4
5	Bladder	9·8	Stomach	5·6

*Numbers too small for ranking.
†ICD 143 and 144.

The comments given below draw attention to some of the more conspicuous ethnic group differences. They are not, nor are they meant to be, exhaustive.

Chinese: The rank order for Chinese given in Table III is virtually the same as that for All Persons given above, oesophageal and liver cancer in males changing 4th and 5th place.

In addition to the outstandingly high incidence of nasopharyngeal cancer in both sexes, oesophageal and primary liver cancer are commoner in males than in many other countries, although still far removed from the oesophagus cancer levels recorded in Iran and Soviet Central Asia and the hepatic cancer incidence observed in Mozambique and other parts of Africa.

The relatively low sex ratio for lung cancer, 3·5:1, is of interest as, for example, in U.K. the ratio is 7:1. The male rate for larynx cancer is elevated, being about 25% of that for lung cancer. This minimum rate is, however, one third lower than that for male Indians and Pakistanis.

The rate for malignant trophoblastic disease is very high compared to other countries. Further details are given by Shanmugaratnam *et al* (1971).

The low rates for prostatic cancer are of great interest. With few elderly persons in the community prostatic cancers are likely to be infrequent, nevertheless, the age-standardized rates which allow for the age-distribution of the population are very low.

The relatively high proportion of Secondary and Unspecified Neoplasms is not unexpected as a proportion of patients with widespread cancer are not exhaustively investigated. In Chinese, as in the other three ethnic groups, microscopically diagnosed cancer of the female breast is less common than cancer of the cervix uteri, the reverse of the occidental pattern.

Malays: The overall rates for Malays are much lower than for other groups. While there is likely to be considerable under-reporting, it is nevertheless interesting to note that lung cancer is the commonest form of microscopically diagnosed cancer in male Malays and that the *minimum* rate for nasopharyngeal cancer, although but one-third of that for male Chinese, is from 5 to 20 times greater than for most other populations in the world. The rates for gastric cancer are very low.

Malignant trophoblastic disease is relatively common. The rates for female breast cancer are of the same order as those in Chinese and Indian and Pakistanis whereas the rates for cancer of the cervix uteri are considerably lower. The existence of several cases of penile cancer in this Muslim population should be noted, although the incidence is but one-tenth of that in Indians and Pakistanis and one-third of that in Chinese.

Indians and Pakistanis: The pattern of cancer in this group, largely of Southern Indian origin, is quite different to that in Chinese or Malays. In both sexes cancer of the mouth is very common, oesophageal cancer is equally common in both sexes whereas it is five times more frequent in Chinese males than in Chinese females. Gastric cancer is less frequent than in Chinese males.

Cancer of the larynx in males is commoner than in Chinese males and, as noted above, in contrast to Chinese males, is considerably more frequent (and of higher incidence) than lung cancer. Indeed the low rates for lung cancer in Indian and Pakistani males are quite unexpected.

Cancer of the cervix uteri is almost twice as common as in Chinese women, although female breast cancer is of the same order in all three racial groups. Penile cancer is relatively common.

Cancer of the bladder is commoner in male Indians and Pakistanis than in either Chinese or Malays, whereas the rates in females are much the same in all three ethnic groups.

Other Races: The rates for Other Races are based on small numbers of cases, and pertain to a wide variety of ethnic groups, Arabs, Ceylonese, Eurasians, Europeans, Jews, etc. It is thus impossible to assess the significance of the elevated female rate, for nasopharyngeal cancer, which is moreover based on a small number of cases. The rate for skin cancer, other than malignant melanoma, is 4 times greater than in Chinese or Indian and Pakistani males and females respectively, and is presumably due to the European moiety of this mixed population. (It is interesting to note that despite differences in intensity of pigmentation the rates for skin cancer in Chinese and Indians and Pakistanis of both sexes are very similar).

DISCUSSION

Reliability of the Data

The data presented are reliable in the sense that they are founded on a diagnostic method of great precision, yet they are not representative to the extent that being microscopically diagnosed there will perforce be a relatively greater number of those types of cancer where biopsy is readily performed, e.g. skin, cervix uteri, nasopharynx and a rather small proportion of cases where tissue is more difficult to obtain, e.g. pancreas, lung and brain. If a large proportion of dead were necropsied, then the deeper seated and more obscure malignancies would eventually be examined, but as has been shown (Muir, 1964), in Singapore, as elsewhere, the proportion of all dead necropsied falls with advancing age and hence this source of microscopically diagnosed cancer becomes steadily smaller as cancer incidence steadily increases. Further, at any age, fewer females than males are necropsied.

As indicated previously we consider the cases of cancer in the numerator to pertain only to Singapore residents. The denominator is based on the 1947 and 1957 censuses. The period covered lies outside these censuses and therefore it is assumed that the same trends of migration and of population increase continued from 1957 to 1964. Our reasons for considering this to be a fair assumption are given elsewhere (Muir, *et al* to be published).

As noted before, the rates quoted are minimum. It is possible that the ethnic group differences in risk shown in Table II do no more than reflect differential utilization of medical facilities. It is a matter of common observation that Malays use all forms of medical care to a lesser degree than the average, whereas Indians and Pakistanis are probably the most health conscious group. To quantify this impression we have computed age-standardized biopsy rates for 1962, the mid-point of this survey (Table IV). These figures, which pertain to all biopsies, not only those found to have cancer, would confirm that for one aspect of health care, namely the taking of a biopsy, there are considerable ethnic group differences. While these biases may affect the data presented, they certainly have not occurred "across the board . . ." as evidenced by the different rates for oral cavity and nasopharyngeal cancers. We therefore believe that many of the ethnic differences shown are true although the absolute level may differ from the figures given.

TABLE IV

AGE-STANDARDIZED (ASR) BIOPSY RATES PER 100,000 POPULATION PER ANNUM BY RACE, SINGAPORE 1962

Race	Males		Females	
	No. of Biopsies	ASR	No. of Biopsies	ASR
Chinese	3,082	146·9	5,364	212·0
Malays	249	63·0	424	93·3
Indians & Pakistanis	551	158·1	559	321·9
Other Races	78	94·2	145	166·9
All Races	3,960	135·1	6,492	201·8

It will be remembered that considerably less confidence can be placed on rates based on 10 or fewer cases.

Racial Group Differences: The racial group differences demonstrated must be used to elucidate aetiology. There is little point in demonstrating a difference if no attempt is made to investigate why. It is relatively easy to explain some of the differences shown (Table II)—the high level of buccal cavity cancers in Indians of both sexes is likely to be associated with betel quid chewing. It is less easy to explain the nasopharynx cancer differences; the high risk in Chinese, intermediate risk in Malays and low western-European level risks in

Indians and Pakistanis. That these differences occur within one very small country with a unified pattern of medical services is much more likely to be significant than if the same differences had been found in three separate countries with different medical services. Aetiological studies are a worthwhile investment as without a knowledge of aetiology there can be no rational prevention.

ACKNOWLEDGEMENTS

This work could not have been carried out without the co-operation of the Singapore Government, University and Medical Profession. Miss Cheong Wai Kan and Mr. Cheah Hong Huat were responsible for maintenance of the records, Dr. N. Stenhouse wrote the computer programmes, Mrs. J. Nectoux and Miss D. Magnin prepared the data for computer analysis. Mrs. J. Nielsen-Kolding typed the script.

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