

FEMORAL NECK FRACTURES AMONG THE MAJOR RACIAL GROUPS IN SINGAPORE. INCIDENCE PATTERNS COMPARED WITH NON ASIAN COMMUNITIES. No. II.

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INTRODUCTION

In an article being published elsewhere the epidemiology of fractures of the hip in the mixed Asian population of Singapore is discussed. The present paper carries this study further. The fracture figures have been broken up into the major racial groups, and the various incidence patterns deduced are compared one with the other as well as with those of other epidemiologic areas. Attempts are also made to explain the variations in these patterns.

This work will be extended when further data become available.

POPULATION AT RISK

The Singapore population according to the 1957 census was 1,445,929. This is made up of Chinese, 75%, Malays, 14%, and Indians 9% with small communities of Europeans and Eurasians (2%). This is the census used in the present paper* Table Ia shows the population at risk (excluding Europeans, Eurasians) by race, sex and 5 year age groups.

MATERIAL

The present survey comprises 691 fractures of the femoral neck from a period from 1957 to 1963 inclusive i.e. 7 complete years. The very small number of femoral neck fractures yielded by the European-Eurasian communities during this period have been excluded from this study.

There are 564 fractures or 81.6% of the total among the Chinese, of which 324 or 57.4% are males, and 240 or 42.6% are females, 20.7% of the males and 7.9% of the females are below the age of 50.

There are 90 fractures or 13% of the total among the Indians, of which 68 or 75.6% are

males, and 22 or 24.4% are females; 30.9% of the males are below the age of 50, a girl aged 16.

The Malays have yielded very few fractures over the 7 years; only 37, or 5.4% of the total, of which 23 or 62.2% are men and 14 or 37.8% are women, 30.4% of the men and 21.4% of the women are below the age of 50.

The entire material according to race, sex and 5 year age groups is presented in Table II.

The percentage of fractures contributed by each sex of each race divided by the latter expressed as a percentage of either the total male or female population under survey is graphically represented by Figures Ia, Ib.

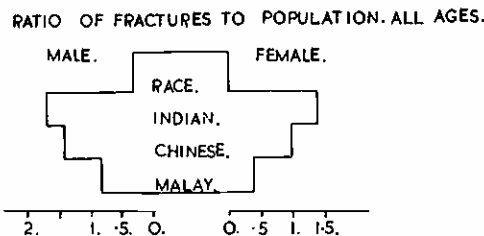


Fig. 1a.

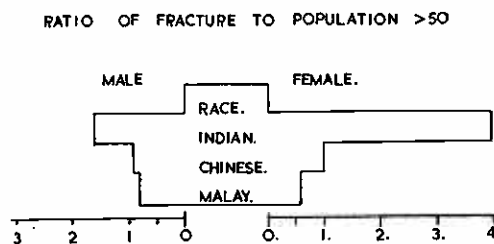


Fig. 1b.

In the Material there are 8 children, two boys and six girls. They range in age from 6 to 16 years. Among the Chinese children there are 3 girls, 2 age 12, and 1 age 8; and 2 boys age 15. There is one Indian boy age 12 and 1 Indian girl age 6. There are 2 Malay girls, age 6 and 7.

* With existing fertility rate the projected Singapore population for 1962 has been calculated to be 1,714,000. Obviously if this figure is used instead of the 1957 one the age specific rates of fractures for both sexes must necessarily be less than the present calculations.

TABLE IA
SINGAPORE POPULATION BY RACE
SEX AND AGE 1957
(age 40 and above, in thousands)

AGE	MALAYS		CHINESE		INDIAN	
	M	F	M	F	M	F
40-44	4.5	3.3	29.5	27.8	7.8	1.2
45-49	3.4	2.8	27.4	24.5	6.0	0.8
50-54	2.6	1.9	22.1	19.5	3.7	0.5
55-59	1.9	1.3	15.8	14.7	2.4	0.4
60-64	1.1	0.9	9.7	10.8	1.0	0.2
65-69	0.6	0.6	5.5	7.7	0.4	0.1
70-74	0.4	0.4	2.7	4.7	0.2	0.1
75-79	0.2	0.2	1.1	2.5	0.1	0.02
> 80	0.2	0.4	0.5	1.5	0.06	0.04

TABLE IB
SINGAPORE FEMALE POPULATION 1957
(all races, 50 and above, in thousands)

AGE	
50-54	22.5
55-59	16.9
60-64	12.3
65-69	8.6
70-74	5.3
75-79	2.8
> 80	1.9

TABLE II
FEMORAL NECK FRACTURES
1957-63

AGE	CHINESE		INDIAN		MALAY	
	M	F	M	F	M	F
< 40	43	12	10	1	4	3
40-44	12	4	6	0	3	0
45-49	12	3	5	0	0	0
50-54	32	6	7	1	1	0
55-59	48	18	11	4	4	1
60-64	43	40	14	4	3	2
65-69	44	38	7	3	2	0
70-74	35	51	3	2	2	2
75-79	31	25	2	2	2	1
> 80	24	43	3	5	2	5

TABLE III
AVERAGE AGES

RACE	M	F	Series
Chinese	59.8	67.0	62.9
Indian	54.8	67.0	57.8
Malay	57.0	62.5	59.0
Australian	72.0	78.0	76.0

TABLE IV
MALE TO FEMALE RATIOS

RACE	< 50	> 50	ALL AGES
Chinese	3.5	1.2	1.4
Indian	21.0	2.2	3.0
Malay	2.3	1.6	1.8

FEMALE/MALE RATIOS

	ALL AGES
AUSTRALIANS	3.0
SWEDISH	3.5
ENGLISH	2.3
SCOTTISH	2.8

TABLE V
FEMORAL NECK FRACTURES ANNUAL INCIDENCE PER 10,000

AGE	CHINESE		INDIAN		MALAY		DUNDEE	MALMO
	M	F	M	F	M	F	F	F
40 - 44	0.6	0.2	1.1	0	0.9	0	—	—
45 - 49	0.6	0.2	1.2	0	0	0	—	—
50 - 54	2.0	0.4	3.0	3.0	1.0	0	2.0	4.0
55 - 59	4.0	2.0	7.0	7.0	3.0	1.0	4.0	7.0
60 - 64	6.0	5.0	20.0	29.0	4.0	3.0	6.0	12.0
65 - 69	11.0	7.0	25.0	71.0	5.0	0.0	12.0	22.0
70 - 74	19.0	16.0	21.0	29.0	7.0	7.0	36.0	39.0
75 - 79	40.0	14.0	29.0	143.0	14.0	7.0	37.0	52.0
> 80	76.0	41.0	71.0	179.0	14.0	18.0	97.0	117.0

TABLE VI

CRUDE RATES			STANDARDIZED RATES	
Annual incidence, age 50 and above Per 10,000				
RACE	MALE	FEMALE	MALE	FEMALE
INDIAN	9.0	22.0	14.0	29.0
CHINESE	6.0	5.0	9.0	5.0
MALAY	3.0	3.0	4.0	2.0
DUNDEE	—	17.0	—	11.0
MALMO	—	23.0	—	16.0

RESULTS AND INFERENCES:

AVERAGE AGE

These were calculated for each of the racial groups as a whole as well as for the males and females of such groups. (Table III). Compared with series elsewhere, the local averages are very much lower both with respect to these racial groups as a whole as well as their corresponding females and males. C.f. a series described by Kern (1962) in which the females averaged 78 and the males 72, with the average for the whole series 76 years.

This is explained by the comparatively high percentage of the local material being under the age of 50.

THE MALE OF FEMALE RATIO

This, as previously, is defined as the number of males divided by the number of females in a particular series. Three were determined for each racial series — for a series as a whole, for those below the age of 50 and for those 50 years and above. These are tabulated in Table IV. With the exception of those below the age of 50 where the order is Indian, Chinese and Malay, generally the Indians have the highest ratios, and the Chinese the smallest. In other epidemiologic areas it is a female to male ratio. Eg. in Malmo, Dundee, Oxford and Sydney it is 3.5 females to 1 male, 2.8 to 1, 2.3 to 1 and 3 to 1 respectively. Below the age of 50 these ratios are at their maximum; two factors contribute to this (but there are probably more) —

1. That there are more males at risk than females below the age of 50.
2. That below the age of 50 there is a greater severe accident rate among males than females.

The ratios for those aged 50 and above are less, and among the Indians and Malays, but not among Chinese (where the female population is greater than the male) it can again in part be explained by the greater male population at risk and a greater severe trauma rate among them.

AGE SPECIFIC RATES

The age specific rates were calculated for the three Races from the population figures

(Table Ia) as the annual incidence of fractures per 10,000 males or females in each 5 year age group.

The incidence among the males of the three ethnic groups in the age groups below the age of 50 in comparison with non-Asian communities is believed to be high. Unfortunately there are no non Asian equivalent data for comparison.

The specific rates are calculated for all the Males and Chinese females from 40 onwards. There are no Indian or Malay women in these age groups.

The results are presented in table V and shown graphically by Figures 2a, 2b.

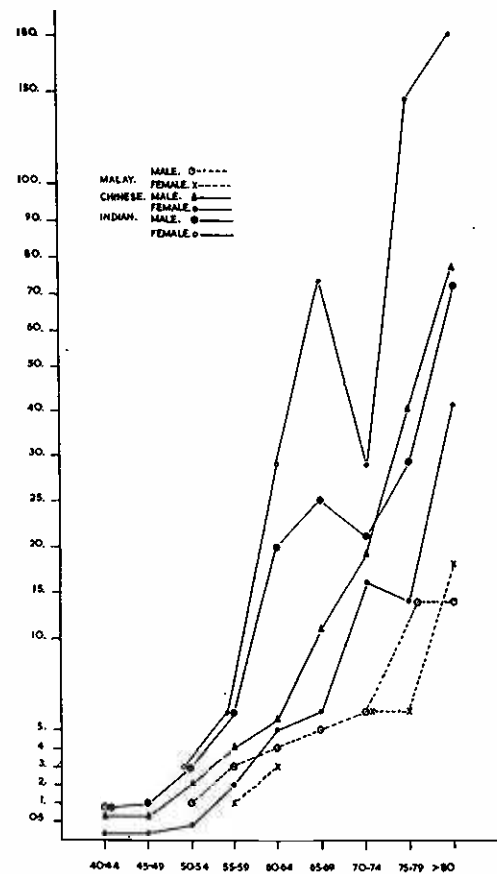


Fig. 2a.

CHINESE

Throughout life the male incidence approximately doubles with each 5 year increment in age. The female rates also rise with equivalent increments in age but with a far less tendency to doubling as in the males.

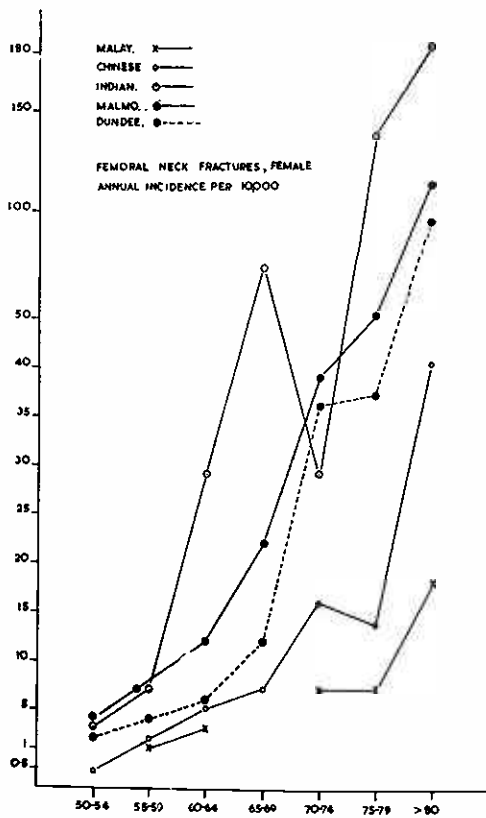


Fig. 2b.

The male incidence exceeds the female in all the 5 year age groups.

MALAYS

There are no female cases recorded in the 50 to 54 or in the 65 — 69 groups. Although the fracture incidence rises with each 5 year increment there is not the tendency to doubling either in the males or females. Male incidences more or less coincide with the female where ever comparison is possible.

INDIANS

Generally the male and female rise with the same age increments; there is no tendency to doubling. From 50 to 64 the male and female incidences roughly approximate and there after the female exceed the male.

The local incidence patterns clearly indicate:

1. Irrespective of sex the highest incidences are among the Indian females and the lowest among the Malay females.
2. Among the females the order of incidences is Indian, Chinese and Malays.

3. Among the Males the same order as the females holds i.e. highest among the Indian Males, lowest among the Malays, with the Chinese in between.
4. Among the Chinese, male incidences exceed the female in all the 5 year age groups but among the Malays, male incidences more or less coincide with the female wherever comparison is possible.
5. The Indian Males have incidences which approximate or are superceeded by their females.

The local male specific rates have no non-Asian equivalent data for comparison.

Compared with the Dundee and Malmo females, the Chinese and Malay rates are very much lower.

Of the females of the races only the Indian rates are at all comparable with the ones in Dundee and Malmo; bearing resemblances to the European rates in some instances and exceeding in others. They also show the sharp rises in the later age groups characteristic of the European Societies.

When the Singapore age specific rates graphs are compared with that for Oxford, England, (Buhr & Cooke 1959) those of the Chinese and Malays differ considerably. But apart from one point of difference i.e. in Oxford the females cross the males to superceed the latter at an earlier age, the Indian community show a close analogy to the English one.

CRUDE AND STANDARDIZED RATES

Crude and Standardized rates at all ages 50 and above per 10,000 of population have been calculated for both sexes of all the races as well as for the Dundee and Malmo females. The Singapore female population age 50 and above has been taken as the standard population (Table Ib). The results are tabulated in Table VI. The very low Malay female rate is partly explained by the absence of cases in the 50-54 and 65-69 age groups.

DISCUSSION

In a previous article — “Epidemiology of Fractures of the Hip in a Mixed Asian Community, Singapore,” the investigation was

carried out on the population as a whole, and the material was collected from the period 1955 to 1962. The present survey extends over different years, 1957 to 1963, and considers the major racial components that make up the Singapore community. But whether analyzing the local population as a mixed community or as its individual major racial components, one constant finding emerges — femoral neck fragility (and therefore cancellous bone) increases with age. This, of course, has been a general observation in Western Communities as early as 1824 (Astley Cooper) and has again been given prominence in recent years by Stewart (1955), Buhr & Cooke (1959), Bauer (1961) and Alffram & Bauer (1962).

As may be expected, other important findings emerged from the present survey which were not recognized in the earlier investigation.

Perhaps the most important is the fact that the increase in fragility in cancellous bone with increase in age among both the Malays and Chinese is not as dramatic as that occurring among the Europeans or Indians.

It is also observed that in relation to the size of its age 50 and above population, (admittedly small) the Malays (and especially the females) have produced extraordinarily few femoral neck fractures. The Indians however, are in direct contrast. (Figure 1b). Among the Chinese, the greater male fracture incidences over the female occur in the presence of a greater female population. In contrast Indian female incidences which either approximate or exceed the male occur in the presence of an overwhelmingly greater male population. In the population age 50 and above, where males are more than females, fracture rates for the Malay males and females coincide pretty closely wherever comparison is possible.

Of the local female incidence patterns, only that of the Indian females is at all comparable with those of Oxford, Dundee and Malmo.

The order of incidences is clearly established as thus: the lowest incidences of femoral neck fractures occur among the Malays and the highest among the Indians with the Chinese population between the two.

Requiring further interpretation are:

1. Reasons for the existence of three different fracture patterns.
2. Why male incidences are greater than female among the Chinese; and why among Malays, male and female rates agree so closely wherever comparisons can be made.
3. Why incidences among the Chinese and Malay females are lower than those of their European counterparts.
4. Why, of the three Races the Indian fracture pattern bears the closest analogy to those of Europe.

Can these be explained according to exoskeletal factors (which include the factors of Buhr and Cooke (1959) and major trauma), or endoskeletal factors, which include the anabolic steroid-osteoporosis relationship and diet. (Reifenstein 1957, Buhr and Cooke 1959, Bauer 1961, Alffram and Bauer 1962)?

Or are the local characteristics a matter principally of Race (Trotter et Al 1960)?

The increased tendency for older people to fall because of the common defects associated with the aged (exoskeletal factors of Buhr and Cooke) undoubtedly contribute to the increased fracture incidences with age in both sexes and in all the races, Asians included. But such causes do not in any way explain the existence locally of the three incidence patterns, nor why Chinese males have higher fracture incidences than their females, nor do they explain the close correspondence between the male and female incidences among the Malays.

Major trauma contributes but to a very limited extent towards any explanation of the characteristics of the local fracture patterns. This has already been pointed out in a previous article.

In the present survey it may be argued that because there is a different anabolic steroid-osteoporosis relationship for each racial group there are three different incidence patterns etc. (unlikely), or that the anomalies are further evidence of the lack of correspondence between osteoporosis incidence and fracture incidence (likely), or that bone fragility and osteoporosis are two different diseases (possible).

It is difficult to conceive diet not playing an important role in the aetiology of bone fragility in spite of Bauer's (1961) opinion to the contrary. But how great a part it plays in the production of the fracture patterns among the races in this community it is difficult to measure. Diet information concerning the local population is extremely scanty, but it is known that in Malaysia (including Singapore) it is below that of European communities.

The value of 2555 calories (deficient in protein and low in calcium) per capita per day as given by May & Jarcho (1961) does not give an accurate picture, for the more prosperous is almost certainly responsible for a considerable share of this figure. It is probable, therefore, that that portion of the different races among whom femoral neck fractures are rife, the diet falls far below the latter value.

It is also known that in the family units "the husband and children get a higher intake of every thing because they eat more of everything, and the best morsels are kept for the husband first, children next and the wife last." (Lewellyn-Jones 1962).

The best fed are the Chinese. Of the Malays and Indians both are poorly off, but the latter more so. If diet alone is considered paramount in determining the fragility of bone it would not be unreasonable to expect rates for Malay and Chinese women to be at least comparable with if not actually exceeding those of Malmo and Dundee. Similarly Malay females should produce greater incidence than the Chinese females, and both should exceed their males in rates. The findings have not been so, in fact the survey results seem to be overwhelmingly in favour of Bauer's suggestion that bone fragility is not related to diet. This however, may still be apparent rather than real, since it is not yet known what happens to fracture incidence patterns of similar races under varying conditions of diet.

Differences in incidence patterns may well be explained on racial grounds. Some support to this hypothesis is found in the work of Trotter et Al who find that the American Negro skeleton is of greater density than that of the American White skeleton. Thus until there is more definite evidence to the contrary it is believed that the Malay and Chinese

female skeletons are of greater density than their European sisters, and that of the three major racial groups in Singapore the Indian female skeleton is the least dense of all.

CONCLUSION

It is believed, with reference to cancellous bone, that the present investigation offers evidence that similar races under similar conditions of diet will produce similar fracture patterns.

Thus in Malmo and Dundee fracture patterns are comparable because the two populations are of comparable races living under equivalent dietary conditions.

Also, of the three races in Singapore there is more similarity in the fracture patterns between the Chinese (who are essentially of Mongoloid composition) and the Malays (who are predominantly of Mongoloid composition) than between those of the latter and that of the Indians (who are of Caucasoid composition), see Del Tufo 1949. It may likewise be reasoned that the Indian fracture pattern bears a closer relationship with that of the Europeans (who are of caucasoid composition), again because of the common factor of racial composition.

Instances where Indian fracture rates exceed those of their European counterparts may well be regarded as indications of the vast discrepancies in diet between the two like races.

Perhaps even greater support to this concept is found in the writer's discussion of "The Epidemiology of the Fractures of the Forearm among the Major Racial Groups in Singapore," where it has been found that fracture patterns of the distal forearm (cancellous bone) among the females of similar racial composition bear even greater similarity one to the other.

Whether the local patterns are normal or abnormal, however, can only be known if fracture epidemiologic surveys are conducted upon races similar to those of Singapore living elsewhere under varying dietary conditions.

SUMMARY

An epidemiological survey of fractures of the femoral neck among the major racial groups (Chinese, Malays and Indians) was

conducted using material collected from a period around 1957-1963. The results were compared and contrasted with similar results from European Communities. Conclusions drawn from the survey were:

1. Among all the races there was an unusually high proportion of femoral neck fractures below the age of 50.
2. Irrespective of race, sex distribution of the fractures were invariably in favour of the male.
3. All the three races respected the law that cancellous fragility is progressive with age but that the trend which it takes is influenced by race.
4. Among races of Mongoloid extraction cancellous bone in the aged male is equally or more fragile than the female.
5. Support opinions that diet is unimportant in the progressive weakening of cancellous bone with age.
6. Further indicate the lack of correspondence between osteoporosis incidence and fracture incidence thereby lending support to suggestions that bone fragility and osteoporosis may be separate entities.

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