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EPIDEMIOLOGY OF FRACTURES OF THE FOREARM AMONG THE MAJOR RACIAL GROUPS IN SINGAPORE

2. Incidences Compared. (A Preliminary Study)

By

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INTRODUCTION

In a previous paper "Epidemiology of the Fractures of the forearm in a Mixed South East Asian Community, Singapore", the material was discussed as that arising from the population as a whole.

It is the object of the present study to use the same material but to break it up into the three major racial groups, Chinese, Malays and Indians (including the Ceylonese) and compare the fracture patterns deduced one with the other and with that of a European Community (Malmo, Sweden).

It is to be emphasized that this is a preliminary survey only and the study will be extended when more data become available.

THE POPULATION AT RISK

The Singapore Community of 1,445,929 persons is made up of Chinese 75 per cent, Malays 14 per cent, Indians and Ceylonese 9 per cent and 2 per cent of Eurasians and Europeans. That part of the 1957 census (which is the one used in the present study) showing the population by Race, sex and 20 year age groups is shown in Table 1. The small community of Eurasians and Europeans have produced only a small number of forearm fractures during the 1962-63 period and are not included in the material under analysis.

MATERIAL

There are 1699 forearm fractures, and for convenience of description they are subdivided thus:

1. Fractures of the distal radius or ulna or both (defined as fractures within 3 cms of the radio-carpal joint). There are 996 cases.
2. Fractures of the shafts of the radius or ulna or both. (618 cases).
3. Fractures of the proximal radius *i.e.* head and neck (41 cases).
4. Fractures of the Olecranon. (42 cases).

These fractures according to Race, sex and 20 year age groups are shown in Tables 2, 3, 4 and 5.

TABLE 1
Singapore Population by Race, Sex and Twenty-Year Age Groups in 1957.

Age group in thousands	Malay		Chinese		Indian	
	M	F	M	F	M	F
0 - 19	53.1	53.4	303.4	281.4	26.6	23.1
20 - 39	35.3	28.7	138.0	139.8	37.8	11.6
40 - 59	12.4	9.3	94.8	86.5	19.9	2.9
> 60	2.5	2.4	19.5	27.2	1.7	0.5

TABLE 2
Fractures of the Distal End of Forearm in Singapore 1962-1963.

Age group	Malay		Chinese		Indian	
	M	F	M	F	M	F
0 - 19	91	10	258	49	84	25
20 - 39	21	3	102	20	29	9
40 - 59	15	9	52	63	48	11
> 60	4	4	33	43	9	5
Total	131	26	445	175	170	50

TABLE 3
Fractures of the Shaft of the Radius or Ulna or Both in Singapore 1962-1963.

Age group	Malay		Chinese		Indian	
	M	F	M	F	M	F
0 - 19	97	30	200	37	80	30
20 - 39	11	2	49	7	12	4
40 - 59	3	0	19	6	15	1
> 60	1	0	11	4	1	0
Total	112	32	279	54	108	35

Definitions (after Alffram & Bauer 1962):

Children (boys and girls) are defined as being from 0 year to 19 years; young adults 20-39, middle age 40-59, and old age as from 60 years upwards.

Age Specific Rates: Age specific rates are calculated from the population figures

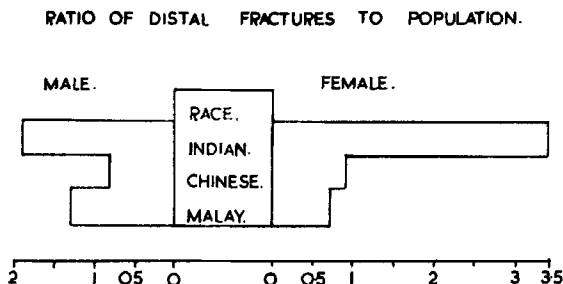


Fig. 1.

Ratio of percentage of distal forearm fractures divided by the population percentage of each sex of each race in Singapore.

(Table 1) as the annual incidence of fractures per 10,000 males or females in each 20 year age group.

The racial composition of the polyglot population of Malaya (and this applies equally well to Singapore) excluding Europeans and Eurasians, consists of (*Del Tufo* 1949):

1. Malays, racial composition, predominantly *Mongoloid*.
2. Chinese, racial composition, essentially *Mongoloid*.
3. Indians, racial composition, *Caucasoid-Carpetarian*.

RESULTS FROM THE SURVEY

Distal Fractures:

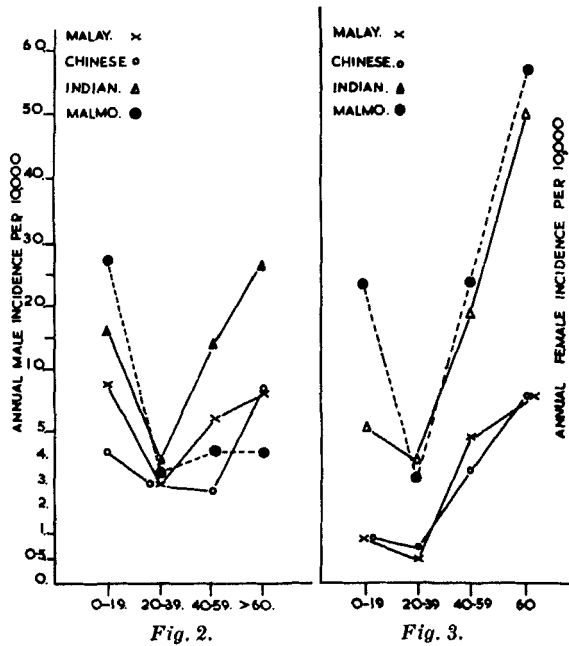
There are 997 distal forearm fractures of which 157 or 15.7 per cent of the total are Malays, 131 or 83.4 per cent are males and 26 or 16.6 per cent are females.

The Indians contribute 220 or 22.1 per cent; 170 or 77.3 per cent are males and 50 or 22.7 per cent are women. The Chinese make up the remainder which is 620 or 62.2 per cent of the total. The males of the latter number 445 or 71.8 per cent and the females 175 or 28.2 per cent.

The racial groups expressed as a percentage of the total population and the percentage of fractures contributed by each are shown in Table 6 and the ratio of percentage of fractures divided by population percentage of each sex of each racial group is graphically represented by Fig. 1. In relation to the size of its population the contribution of fractures by both the Indian Males and Females is considerable.

Males (Fig. 2):

In all age groups Indian males have the highest incidences; and among the boys and young adults they are followed by the Malays and



Figs. 2 and 3.

Annual male and female incidences of fractures of the distal forearm per 10,000 of population according to age among the major races in Singapore.

then the Chinese, but in middle age the Malay incidence exceeds the Chinese; and in old age Malay and Chinese incidences approximate. For the Chinese the lowest incidence occurs in the 40-59 groups where as among the Indians and Malays this occurs among the young adults.

Compared with Malmo the rates for the local boys are considerably lower. Among young adults, Chinese, Malay, Indian and Malmo rates correspond reasonably closely. In middle age the order is Indian, Malay, Malmo with the Chinese least of all. All the local incidences exceed that of the Swedish Community in old age.

Females (Fig. 3):

Malay and Chinese females have incidences which correspond very closely in all the four age groups. Their girls and young female adults have rates which are below their boys and young male adults, but in middle age and the aged, male and female incidences are almost identical.

Indian female rates are the highest for the three Races in all the age

RATIO OF SHAFT FRACTURES TO POPULATION.

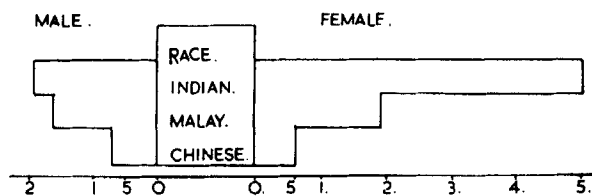


Fig. 4.

Ratio of percentage of shaft fractures divided by the population percentage of each sex of each race in Singapore.

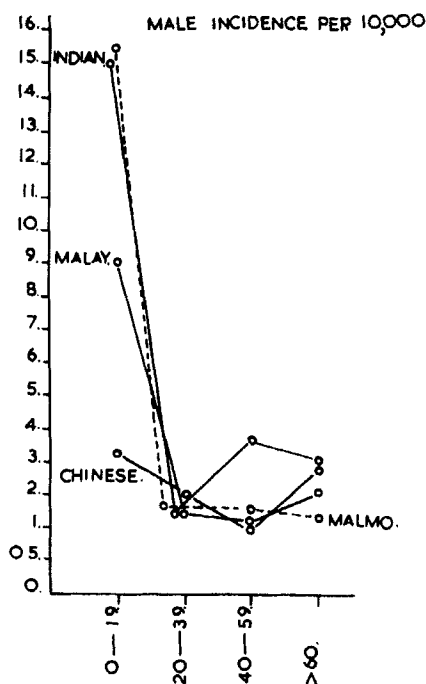


Fig. 5.

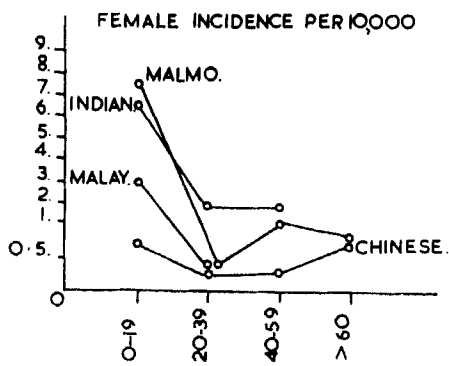


Fig. 6.

Figs. 5 and 6.

Annual male and female shaft fractures per 10,000 of population according to age among the major races in Singapore.

groups. They exceed their males in middle and old age and correspond fairly well with those of the Swedish females in all except the girls.

Both the Chinese and Malay female rates are considerably below those of the Indian and Swedish females.

TABLE 4
Fractures of the Proximal Radius in Singapore 1962-1963.

Age group	Malay		Chinese		Indian	
	M	F	M	F	M	F
0-19	0	4	11	2	2	3
20-39	2	0	5	1	4	2
40-59	0	0	2	1	1	1
> 60	0	0	0	0	0	0
Total	2	4	18	4	7	6

TABLE 5
Fractures of the Olecranon in Singapore 1962-1963.

Age group	Malay		Chinese		Indian	
	M	F	M	F	M	F
0-19	4	0	18	2	4	2
20-39	1	0	0	0	1	0
40-59	0	0	2	2	1	0
> 60	0	0	2	2	1	0
Total	5	0	22	6	7	2

TABLE 6

	Percentage of population		Percentage of fractures	
	M	F	M	F
<i>Chinese</i>	74.5	80.2	59.8	70.0
<i>Malays</i>	13.9	14.1	17.5	10.4
<i>Indians</i>	11.6	5.7	22.7	19.6

Evidence from the present survey suggests the existence of three fracture patterns for the distal forearm in Singapore. Among the females the Malay and Chinese patterns resemble one another very closely whilst the Indian one bears close analogy with that of Malmo. There is not the same agreement among the various male patterns as there is among the females.

Shaft Fractures:

There are 620 fractures of the shaft of the forearm bones. The Malays total 144 or 23.2 per cent of the total, 112 or 77.7 are men and 32 or

22.3 per cent are women. The Chinese number 333 or 53 per cent of the total, 279 or 83.8 per cent are men and 54 or 16.2 per cent are women. There are 143 or 23.1 per cent of the total fractures among the Indians of which 108 or 75.5 per cent are men and 35 or 24.5 per cent are women.

Approximately $\frac{3}{4}$ of the fractures in each race occur in childhood and are rare among the women thereafter, especially among Malay and Indian women. The ratios of the percentage of fractures divided by the percentage population of each sex of each race are diagrammatically represented by Fig. 4.

There is considerable similarity among all the males, Malmo included, in young adults, and with the exception of the Indians this similarity exists among the middle aged also (Fig. 5). Among boys, however, the Indian and Malmo incidences are identical; the Malay rates are less with the Chinese even lower. The order in old age is Indian, Malay, Chinese and then Swedish, but the differences one from the other are small.

There are no fractures of the shafts of the forearm bones beyond young adults among the Malay females and none beyond middle age for Indian females. Among girls the order is Swedish, Indian, Malays and Chinese (Fig. 6). There is considerable correspondence among all young adults except the Indians. In middle age the order is Indian, Swedish and Chinese; and in the aged the Chinese rate exceeds that of Malmo. Male incidences in all the Races exceed their corresponding female incidences.

The concept of a separate incidence pattern for each race is far less distinct in this fracture than that for cancellous bone.

Proximal Fractures.

Proximal Fractures of the radius and ulna are relatively rare fractures in all the races, rarest among Malays especially the females. There are no recorded olecranon fractures among Malay females and it is an uncommon fracture among Indian females also (Tables 4 and 5).

DISCUSSION

This investigation has confirmed the prediction made in a previous study that with each one of the local races there exists a correspondingly different fracture pattern. It has also been shown that of the two varieties of bone, cancellous and cortical, the former produces a more distinctive pattern than the latter.

Of the three Races the Indian cancellous fracture pattern tends more to the European than the other two. Their female rates in middle and old age exceed those of their male, and correspond fairly closely with those of Malmo.

They also show the dramatic and sharp rise in these age groups characteristic of a European Society—undeniable evidence of progressive fragility of cancellous bone with increase in age. Some evidence of this latter process is found among the Chinese and Malay females but it is hardly comparable to that occurring among the European and Indian females.

Of the local males only the Indians give clear cut evidence of increasing cancellous fragility with age. The Malays and Chinese Males, like those of their females and males of Malmo, give also only little evidence of such a progressive degenerative process.

There is very little evidence of increasing fragility in cortical bone with age in either sex of all the races.

It is tentatively believed that the differences or similarity of fracture patterns (cancellous bone) for each of the local races, is merely an expression of the differences or similarity of racial composition. This was pointed out in the earlier investigation which dealt with the local population as a whole.

The question now arises—are the patterns deduced for each of the major racial group characteristic of that particular race? And as was also pointed out previously this can only be known if epidemiological surveys are conducted upon similar races whether they may be Malay, Chinese or Indian living elsewhere under similar, more adverse or better environmental conditions (most important of which is diet).

The present findings add no evidence to any hypothesis that explains increasing cancellous fragility as a result of osteoporosis which *Reifstein* (1957) has found to accompany the decline of anabolic steroids in aging females.

There is evidence to indicate that diet in Malaysia and Singapore is below that of European Communities in Calories, proteins and calcium (*May & Jarcho* 1961, Household Budget Survey Federation of Malaya 1957–58).

In terms of proteins the Chinese are the best fed, followed by the Malays then the Indians, and in terms of calcium the order is Indian, Chinese then Malay, but both are below recommended values. In all the Races the females fare the worse (*Llewellyn-Jones* 1962).

If dietary considerations were all important in fracture aetiology

why are the Chinese and Malay female incidences so far below, and the Indian female incidences merely comparable with those of a European community? Why is there so close a correspondence between male and female rates among the Chinese and Malays in the older age groups? In Singapore there is thus a considerable lack of correspondence between fracture incidence and the dietary intake of the population. This gives considerable support to *Bauer's* opinion that dietary considerations are unimportant in fractures in the aged.

Yet inspite of strong evidence to the contrary in the present study it is still difficult to imagine dietary considerations being anything else other than extremely important factors in fracture aetiology. It may still be that this lack of correspondence between diet and fracture incidence is apparent rather than real. This, of course, can only be proved or otherwise when races similar to those of the local population living elsewhere are studied with regard to fracture patterns under varying conditions of diet.

CONCLUSIONS AND SUMMARY

The present survey has deduced:

1. That in Singapore distinct fracture patterns for cancellous bone exist for the different ethnic groups, and that similar races produce similar fracture patterns.

2. That among the Indians, in both sexes, there is undoubted evidence of increased cancellous fragility with increase in age, but in both sexes among Chinese and Malays there appears only a little increase in this degenerative process with similar age advances.

3. That the fracture patterns for cortical bone are less distinct. This is probably due to the fact that cortical bone shows little tendency to degenerate with age.

4. That there is a lack of correspondence between osteoporosis incidence (due to decline of anabolic steroids in aging females) and fracture incidence.

5. That there is a lack of correspondence between dietary intake and fracture incidence. This, however, may still be apparent rather than real.

It is again emphasized that when further data become available the present survey will be extended.

RESUME

Il ressort de la présente étude:

1. qu'il existe à Singapour des modèles distincts de fractures des os spongieux chez les différents groupes ethniques et que les races similaires produisent des modèles de fractures similaires;

2. que parmi les Indiens des deux sexes, il y a une évidence indiscutable d'une fragilité accrue des tissus osseux spongieux avec l'âge, alors que dans les deux sexes, chez les Chinois et les Malais, il n'y a qu'une légère augmentation du processus dégénératif aux âges avancés correspondants;

3. que les modèles de fractures pour les os compacts sont moins distincts. Cela est probablement dû au fait que l'os compact ne montre qu'une petite tendance à la dégénération avec l'âge;

4. qu'il existait un manque de corrélation entre l'incidence de l'ostéoporose (due à la diminution des stéroïdes anaboliques chez les femmes âgées) et celle de la fracture;

5. qu'il y a un manque de corrélation entre le régime diététique et l'incidence de la fracture. Cela peut toutefois être plus apparent que réel.

Il est souligné que la présente étude sera complétée lorsque des données ultérieures pourront être obtenues.

ZUSAMMENFASSUNG

Aus der vorliegenden Übersicht schliesst man:

1. Dass in Singapore bestimmte Bruchformen des Markknochen in den verschiedenen Volksgruppen auftreten und dass ähnliche Rassen ähnliche Bruchformen aufweisen.

2. Dass bei den Indern beiderlei Geschlechts mit zunehmenden Alter zweifellos eine zunehmende Gebrechlichkeit der Markknochen vorhanden ist. Bei den Chinesen und Malayen scheint jedoch nur eine geringe Zunahme dieses degenerativen Prozesses mit einer entsprechenden Alterszunahme aufzutreten.

3. Dass die Bruchformen von Röhrenknochen weniger verschieden sind. Dies ist wahrscheinlich auf die Tatsache zurückzuführen, dass Röhrenknochen nur eine geringe Neigung zur Altersdegeneration haben.

4. Ein Mangel von Übereinstimmung zwischen dem Vorkommen von Osteoporosis (wegen der Abnahme von anabolischen Steroiden bei alternden Frauen) und dem Entstehen von Brüchen ist vorhanden.

5. Dass ebenfalls ein Mangel von Übereinstimmung zwischen Er-

nährung und dem Auftreten von Brüchen zu beobachten ist. Dies ist jedoch möglicherweise nur scheinbar und nicht wirklich.

Es wird wiederum hervorgehoben, dass die gegenwärtige Untersuchung ausgeweitet werden wird, sobald weitere Daten erhalten werden.

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REFERENCES

1. *Alffram, P.-A. & Bauer, G. C. H.*: Epidemiology of Fractures of the Forearm. *J. Bone Jt Surg.* 44 A: 105-114, 1962.
2. *Bauer, G. C. H.*: Epidemiology of Fractures in Aged Persons. A Preliminary Investigation in Fracture Aetiology. *Clin. Orthop.* 17: 216-225, 1960.
3. *Buhr, J. A. & Cooke, A. M.*: Fracture Patterns. *Lancet* 1: 531-536, 1959.
4. *Bruns, P.*: Die allgemeine Lehre von den Knochenbrüchen in Deutsche Chirurgie. Vol. 27, Part 1, Stuttgart, Enke, 1882.
5. *Del Tufo, M. V.*: A Report on the 1947 Census of the Population of Malaya. London, Crown Agents for the Colonies.
6. *Household Budget Survey: Federation of Malaya 1957-1958*, Department of Statistics. Kuala Lumpur.
7. *Llewellyn-Jones, D.*: *Med. Journal. Malaya*, 26: 260-266, 1962.
8. *Lugg, J. W. H. & Bonness, J. M.*: A Study of the Relationships between the Twenty-Four Hourly Urinary Outputs of 17 Ketosteroids and Creatinine and Weight of Twenty Adult Male Subjects. From Each of the Six Ethnic Groups. *Austr. J. Exp. Biol.* 35: 395-420, 1957.
9. *May, J. M. & Jarcho, I. S.*: The Ecology of Malnutrition in the *Far and Near East*. 167-180. Haffner Publishing Company, Inc. New York, 1961.
10. *Reifenstein, E. C.*: The Relationship of Steroid Hormones to the Development of Osteoporosis in Aged People. *Clin. Orthop.* 10: 206-253, 1957.
11. *Trotter, Mildred, Broman, G. E. & Peterson, R. R.*: Densities of Bones of White and Negro Skeletons. *J. Bone Jt Surg.* 42 A: 50-58, 1960.