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Geographical Aspects of Acute Myocardial Infarction in India with Special Reference to Patterns of Diet and Eating

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A great deal of evidence is now available to show that the incidence of myocardial infarction varies from place to place and from time to time. Yudkin (1963) has recently reviewed figures of 'mortality due to arteriosclerotic heart disease, including corronary disease' for 26 countries (*Wld Hlth Org.*, 1961), which show that important differences in prevalence of this disease exist not only between different countries but even within a single country. Moreover, the incidence among migrant populations is, in general, intermediate between that found in their original homeland and that in the country to which they have migrated. The Japanese, for example, develop more ischæmic heart disease if they migrate to Hawaii, and these trends are further exaggerated if they settle in the U.S.A. (Gordon, 1957; Larsen, 1957; Keys *et al.*, 1958). It is evident, therefore, that environmental factors play an important part in the development of this disease and that many of them may be preventable.

From a survey of deaths due to arteriosclerosis, including coronary heart disease, among Railway populations in India, conducted by the Ministry of Railways in 1963 (Malhotra, 1966), we were impressed by the geographical variations and so decided to explore morbidity due to myocardial infarction among railwaymen.

Several studies, notably those of Keys *et al.* (1958), have suggested that dietary fats are a major factor in the ætiology of ischæmic heart disease. It is suggested that the liability to develop ischæmic heart disease increases with a rise in the total consumption of dietary fats, or that a higher consumption of saturated fatty acids increases this liability. On the other hand, there are several careful epidemiological studies from many countries, such as the statistical review by Yudkin (1957), which failed to find even a clear-cut correlation between fat consumption and mortality from ischæmic heart disease.

In India the consumption of fats (Indian Council for Medical Research, 1964) and also the pattern of diets and eating (Malhotra, 1964) differ from place to place, and a study of the geographical aspects of myocardial infarction with reference to dietary differences could, therefore, be worth while. The study reported in this paper stems from such an attempt.

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Methods of Investigation

Case Material. The clinical data are derived from the hospital admissions to 24 Railway District Hospitals in different parts of the country (see map in Figure) during the period January 1, 1963 to December 31, 1964. The following methods of case finding were used.

(1) A prepared questionnaire was sent to the various hospitals and they were asked to make a systematic search of their records for patients admitted with a diagnosis of coronary heart disease, acute myocardial infarction, coronary thrombosis, and coronary insufficiency. Through the courtesy of the various units, all the case records were collected in Bombay and were reviewed before acceptance in the final list.

(2) A rough index of the number of case records to be expected was available to the individual units from two sources: (a) the monthly mortality and morbidity returns (W.H.O. International statistical classification) of the units, and (b) sickness-absence certificate books: railway employees have to obtain a medical certificate in case of absence due to illness. These certificates helped to provide an estimate of the number of railway employees who were absent from work during 1963–4 with a diagnosis of acute myocardial infarction, and was especially useful for units where the number of cases was small. In the present inquiry this seemed to us to be a particularly useful way to retrieve, as far as possible, all the case records.

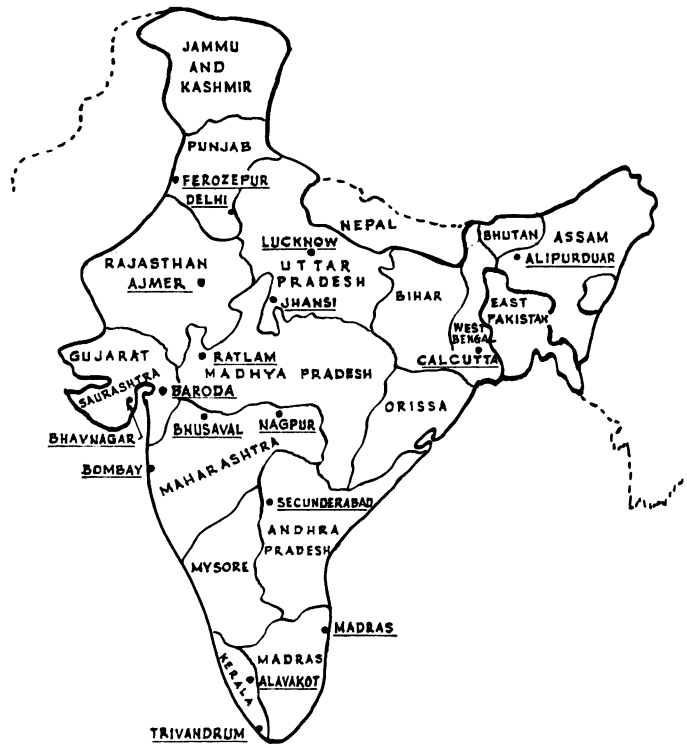

FIG.—Map of India showing the various centres.

The diagnostic criteria for the acceptance of the cases were based on the characteristic signs, symptoms, and electrocardiographic changes for infarction of the myocardium (New York Heart Association Criteria Committee, 1964, Classification 3.40.2).

Altogether, 398 cases were admitted in the provisional lists compiled by the units themselves. Of this total, 104 were rejected. The rejected cases included 20 cases with angina pectoris with electrocardiographic disturbances, 43 that were classified as coronary insufficiency, 11 with hypertension with ischæmic electrocardiographic pattern, and 30 other cases which were excluded because either the information was incomplete, or another diagnosis than acute myocardial infarction seemed likely, or these were second attacks. In 4 instances, death had taken place rather suddenly either on the way to the hospital or soon after admission, but these have been included because the signs and symptoms were characteristic.

The distribution of 294 accepted cases and 104 rejected cases is displayed in Tables I and II and an analysis of the rejected cases is given in Table II.

The number of rejected cases from Madras (South India) was 11 against the following four centres in North India: Delhi 4, Ferozepur 0, Jhansi 4, and Ajmer 8 (Table II). Of the 11 rejected cases of Madras, one was doubtful because another diagnosis seemed likely, 8 showed other manifestations of coronary artery disease though not acute myocardial infarction, and the remaining 2 were rejected because the present admission was not their first attack (Table II). These trends seem to indicate the fact that not only the incidence of acute myocardial infarction but coronary artery disease as a whole is more prevalent in South than in North India.

Population at Risk. Each District Hospital has its own "jurisdiction" and its population drainage is usually precisely known. The population at risk has been worked out by taking into account the annual increase in the number of railway staff (no. of employees for the 2-year period ÷ 2 for each unit (Table I)).

The wives and children of the railway employees have been excluded from this: first, because their number is less precisely known, and secondly because their exclusion would not affect the comparisons between different areas, there being no cases amongst them in this series, possibly because the disease is rare in women before the menopause and rare also in children. The fact that it rarely occurs among women may be explained by the fact that, in our population, the age of wives will be generally below 45 years. The age of superannuation of railway employees is 55 years.

The place of residence of the railway employees is generally the area where they serve. One exception to this are the top executives who are borne on an all-India cadre, and their placement on a particular unit is

TABLE I

ADMISSION OF CASES OF ACUTE MYOCARDIAL INFARCTION FROM JANUARY 1, 1963, TO DECEMBER 31, 1964, TO 24 RAILWAY HOSPITALS IN INDIA

Year	Railway zone	Name of hospital	Employees served	No. of cases of acute myocardial infarction (total 294)	Biennial incidence per 100,000 of employees	Total admissions for all diseases	Admission of acute myocardial infarction expressed as percentage of all admissions
1963–64	Southern	Perambur	60,600	62	102·3	7335	0·84
		Alavakkot	17,600	21	119·3	3585	0·60
1960–61		Secunderabad	30,552	23	75·3	4533	0·5
1963–64		Jhansi	26,850	10	37·2	4148	0·2
,,		Bhusaval	26,730	4	15·0	4707	0·08
,,	Central	Nagpur	15,702	11	70·0	1510	0·7
,,		Jabalpur	18,976	11	58·0	2182	0·5
,,		Sholapur	14,369	8	55·6	3521	0·2
1963–64		New Delhi	55,832	22	39·4	4228	0·5
,,	Northern	Lucknow	45,244	16	35·4	6932	0·2
,,		Ferozepur	27,682	4	14·4	2275	0·2
1963–64	North-east Frontier	Alipurduar	12,944	3	23·2	2273	0·1
		Kathihar	13,021	1	7·6	1420	0·07
1963–64	North-eastern	Gorakhpur	25,000	14	56·0	15,112	0·09
1963–64	South-eastern	Kharagpur	32,366	6	18·5	5693	0·1
		Dohad (Workshop)	4719	5	106·0	3354	0·15
		Bombay	39,438	33	83·6	4507	0·7
		Baroda	27,696	8	28·9	1908	0·4
		Ajmer	27,072	15	55·4	5702	0·2
1963–64	Western	Jaipur	12,560	5	39·9	1178	0·4
		Ratlam	15,881	5	31·5	1451	0·3
		Bhavnagar	14,606	4	27·4	1306	0·3
		Rajkot	19,060	1	5·2	1315	0·08
		Kota	16,051	2	12·4	2212	0·09

TABLE II

ANALYSIS OF 104 CASES NOT INCLUDED IN THE LIST OF "ACCEPTED" CASES OF ACUTE MYOCARDIAL INFARCTION

Serial No.	Hospital	Angina pectoris	Coronary insufficiency	Hypertension with ischæmic changes in E.C.G. tracings	Lack of information, another diagnosis, or second attack	Total
1	Perambur	1	6	1	3	11
2	Alavakkot	3	—	1	7	11
3	Jhansi	1	2	1	—	4
4	Bhusaval	4	3	—	—	7
5	Nagpur	2	—	1	—	3
6	Lucknow	1	9	3	1	14
7	New Delhi	—	3	1	—	4
8	Kharagpur	—	1	2	4	7
9	Jabalpur	—	2	—	—	2
10	Kathihar	—	3	—	—	3
11	Gorakhpur	1	1	—	—	2
12	Bombay	—	2	—	6	8
13	Baroda	1	6	—	—	7
14	Ajmer	1	3	1	3	8
15	Ratlam	—	1	—	1	2
16	Kota	1	1	—	3	5
17	Rajkot	2	—	—	1	3
18	Jaipur	2	—	—	1	3
	Total	20	43	11	30	104

purely fortuitous; and for the same reason their age-structure in different units is not comparable.

Finally, it must be emphasized that this population is a highly selected group, consisting of railway employees between the ages of 18 and 55 years, with the result that older people do not figure in this population. This study cannot, therefore, claim to give an accurate picture of the incidence of myocardial infarction in the general population in the whole country but only of its geographical presentation in railway workers in the different areas studied. One advantage of this population, however, is that because of the uniform administrative patterns of recruitment, promotion, and superannuation, the composition of the populations served by different units is generally comparable with regard to age, sex, socio-economic status, and their relative proportions in various trades, and our results are, therefore, independent of sampling errors dependent upon these factors.

Dietary Factors. The data on the patterns of diets, and methods of cooking and eating were obtained—(a) from interviews with a number of railwaymen and their wives in different geographical areas; (b) from several

roadside eating houses in different parts of the country, which reflect the regional eating habits and patterns of diet, and (c) from official diet surveys (Indian Council for Medical Research, 1964).

Results

The biennial incidence rates (cases first diagnosed 1963–64 divided by the population at risk) have been worked out and expressed as per 100,000 of railway employees (Table I). Perambur (Madras) and Alavakkot, both in South India, show the highest incidence rates for acute myocardial infarction as compared with the centres in the North, such as Ferozepur, Jhansi, or Delhi. The incidence is 7 times higher in Perambur (South India) than in Ferozepur (North India). These geographical trends are also reflected in the admissions for acute myocardial infarction expressed as a percentage of all admissions (Table I).

Although services provided in these hospitals are free of charge and include the wives and children of the railway employees, there were no cases of acute myocardial infarction among women in this series.

Validity of Results

In a study using the retrospective approach a number of difficulties arise.

(1) The accuracy of data which pertain to several different hospitals and in which many different physicians were concerned would suffer from the defect of varying competence in diagnosis. While such differences must have influenced the accuracy of the total incidence rates recorded in this study, they are unlikely to have affected the validity of the comparisons between groups. On the contrary, the large number of physicians concerned introduces a random element which, in the absence of a single uniform opinion, is the best safeguard against bias in favour of any one group. The final acceptance of cases was done by a single cardiologist not directly connected with this study, and this makes for uniformity in the criteria of diagnosis in the final list of accepted cases.

(2) In retrospective studies, it is always difficult to be certain that all cases have been found, and a progressive failure to retrieve records as one searches further back in time is likely. This hypothesis was tested by studying the secular changes in the incidence. For Perambur (Madras) the admission rates in 1961 and 1962 were, in fact, higher than in 1963 and 1964, the number of admissions being 83 and 62, respectively. In the case of Rajkot and Ferozepur the trend was the opposite, i.e. there was an apparent decrease. But in these units the extra source of the sickness absenteeism certificates and the monthly morbidity reports make it unlikely that the finding of cases had suffered because of this.

(3) A number of cases of acute myocardial infarction may not have sought admission if the symptoms were mild, or if the patient died at home before admission. These limitations almost always result in underestimates of frequency but do not detract from the value of the data if the aim, as here, is mainly to define the geographical differences in frequency.

(4) It might perhaps be argued that doctors in the South of India, on the Southern Railway's Hospitals at Perambur (Madras) and at Alavakkot, have more readily diagnosed acute myocardial infarction, thus producing the gradient of morbidity recorded here. As one means of investigating this possibility, the data of the Central Railway, which is an independent Railway system and serves different parts of the South as well as the North, have been analysed. In the hospital at Jhansi (Central Railway) which serves the North, the incidence was 37 per 100,000 as compared with Secunderabad (Central Railway) which serves Northern parts of South India, where the incidence was 75 per 100,000.

A second and perhaps more convincing test of possible bias between different units can be made by comparing the mortality from arteriosclerosis including coronary heart disease, compiled by the Ministry of Railways (Malhotra, 1966). In general, the geographical differences in mortality were consistent with the morbidity trends recorded here, which makes it improbable that differences between the North and the South can be attributed to reasons of bias on the part of doctors. The data of Employees' State Insurance Scheme (Padmavati, 1962), are an extra and independent source to test this as they are also consistent with these trends. Whichever way we choose to look at the problem there is evidence of greater vulnerability of Indians from the South, as compared with those from the North, to develop acute myocardial infarction.

Pattern of Diet and Eating

Differences in dietary patterns and habits exist not only between different parts of the country but even within the same region between different socio-economic groups, and an account of some aspects of this has been published elsewhere (Malhotra, 1964).

Roughage and Fibre Content. The South Indian diets, especially of lower socio-economic groups, are poor in their fibre and roughage content, being composed mainly of high carbohydrate, lipid-poor

régimes of boiled rice, tapioca, or ragi (*Eulicine corcana*) gruel, or rice kanji, which are poor in cellulose and vegetable fibre, as compared with the wheat, whole beans, dhals, and vegetable diets of North India, which are rich in cellulose, vegetable fibre, and roughage content.

Fats. The fat consumption in the South is 8–19 times less than in the Punjab (Indian Council for Medical Research, 1964), the average daily amount in the case of railway sweepers, investigated by us, being 7 g. of seed oils, such as groundnut or sesame oil. The proportion of calories from fat is 3½ per cent of a total of 2400 calories. In the North, on the other hand, average daily consumption of 75 g. mainly ghee and other milk fats and to some extent of vegetable seed oil, such as mustard oil or vanaspathi, provides 23 per cent of calories from fats out of a total of 2800 calories. In the higher income groups the daily fat intake in the North is even higher, being 70–190 g. against 10–30 g. in the South (Padmavati, 1962). Less obvious, but equally important, are the differences in the chemical composition of fats used by these disparate population groups. Milk, ghee, and fermented milk products, which are the main sources of fats in the Punjab and Rajasthan, contain a large proportion (43%) of short-chain lower fatty acids (Hilditch, 1949). The relative proportion of lower fatty acids in the seed oils, such as groundnut or sesame (gingelly) oil is much smaller; and in these the long-chain oleic, linoleic, and palmitic acids are prominent (Nicholls, 1961). The degree of saturation of the fatty acids in the dietary fats of the South Indians versus North Indians also shows big differences. Thus, while the North Indians largely consume fats containing saturated fatty acids, the South Indians eat fat in which the poly-unsaturated fatty acids have a preponderance: the poly-unsaturated fatty acid content of the South Indian seed oils is 45 per cent against 2 per cent in the North Indian ghee and other milk fats (Indian Council for Medical Research, 1963).

Butter-milk prepared from fermented milk, curd, or yoghurt is a favourite drink in the North and its consumption in the South is very small. These contain large quantities of acetic and lactic acids which are the precursors of short-chain fatty acids (Ling, 1963; Hilditch, 1949).

Sugar. The consumption of sugar is 80 g. per consumption unit in the Punjab (North India) as compared with 5–15 g. in South India (Indian Council for Medical Research, 1964).

Methods of Cooking. (i) An important and interesting feature of North Indian diets as compared with the South is that the methods of cooking and eating reduce the size of the fat globules. In the Punjab, Rajasthan, and Gujarat, milk is boiled and allowed to simmer in an open container, and it is then spun from one vessel to another. Homogenization of hot milk in this manner results in a subdivision of the fat globules from 10 to 100-fold (Jensen, 1928, confirmed by Malhotra, 1965, unpublished data), as a result of the agglutinin of fat globules being weakened or destroyed by heat (Doan, 1929). Milk is not heated in this way in the South and its consumption in any case is low (Indian Council for Medical Research, 1964).

(ii) Curd lassee and chhachh (butter-milk) which are prepared by vigorous churning of curd, as described by Rangappa and Banerji (1947), are favourite North Indian fermented-milk drinks, and their use in the South is confined to higher socio-economic groups, but in them also it is sparingly used. The fat globules in these are broken up into fine particles of less than 2 μ (Rangappa and Banerji, 1947).

(iii) For making curries, the practice in the North is to heat ghee or vegetable seed oils with condiments, especially turmeric powder (curocuma domestica) in the manner described by Veeraswamy (1963). This breaks up the fat globules and reduces their size greatly (Malhotra 1965, unpublished observations). Turmeric is used in the south also but instead of heating it with the fat, it is merely mixed with curry as a colouring agent which has no effect on the size of the fat globule. So far as the author is aware, this effect of turmeric powder on heated fats does not appear to have been reported previously.

(iv) Another interesting practice, particularly in Gujarat and parts of Punjab but not in the South, is to add jaggery (unrefined sugar) to ghee for making curries or sweet roti. This is of significance in view of Dole's (1956) observation that sugar when mixed with fats causes a marked decrease in the levels of non-esterified fatty acids in plasma.

"Meal-chewers" versus "Meal-scampers". As reported elsewhere (Malhotra, 1964, 1965), the South Indian foods are sloppy and do not require much mastication, whereas the foods eaten in the North-west of India cannot be bolted down and require thorough chewing, producing much salivation. These differences are of concern, as the chewing movements of the jaw, apart from a possible reduction in the size of the fat globules by homogenization, provide a secretion of saliva having an increased buffer capacity due to an enhanced secretion of bicarbonate (Lilienthal, 1955; Malhotra, 1965; Malhotra, Saigal, and Mody, 1965)

which reduces gastric acidity (Malhotra, 1967a). An upshot of this, as I have already suggested (Malhotra, 1967b), is that meal-chewing results in a reduction in the amount of bile entering the intestinal lumen, possibly because hydrochloric acid, which is the most potent duodenal stimulus of gall-bladder contraction (Hong, Magee, and Crewdson, 1956) may lose its stimulus intensity because of the buffering action of saliva (Malhotra *et al.*, 1965).

Meal Frequency. There are important differences between the North Indians and South Indians of lower-income groups, in meal frequency. While the lower-income group North Indians have only two main meals, the South Indians have three main meals of rice and four subsidiary meals of tea or coffee. We have no evidence of the effect of meal frequency on the digestion and absorption of fats but differences are likely in view of the fact that the entry of food into the stomach causes secretion of acid (James, 1957), and thus meal-frequency may have a possible bearing on the bile flow because of the stimulatory effect of hydrochloric acid on gall-bladder contraction (Malhotra, 1967c; Hong *et al.*, 1956).

Discussion

Several careful epidemiological studies have disclosed that, without exception, the tendency to develop ischæmic heart disease is lower in countries where the fat consumption is low than in those where it is high. (For references see the excellent review by Begg, 1964.) The present study does not support these observations, and we have found the incidence of myocardial infarction to be much lower in the Punjabis on a higher fat intake than in the South Indians on low fat rations. Two recent studies, Shaper, Jones, and Kyobe (1961) and Shaffer *et al.* (1964), which support our general conclusions, have also reported that not only the incidence of atherosclerosis but also the cholesterol levels are much lower in the Samburu tribe in Kenya and the milk-and-meat eating Masai of Tanganyika than those in corresponding Americans, even though the fat content of their diet seems to be at least as high and probably higher than that of most Americans. Our data on serum cholesterol in South Indian versus North Indian railway sweepers, with big variations in their fat consumption, did not show any differences in their mean cholesterol levels (Malhotra, 1967d). This runs parallel to the experience of Walker and Arvidsson (1954) in the South African Bantu, and of the Vanderbilt team (Shaffer *et al.*, 1964) in the Masai of Tanganyika.

Much evidence indicates that consumption of even small quantities of unsaturated fatty acids decreases the liability to ischæmic heart disease (Bronte-Stewart *et al.*, 1956; Kinsell *et al.*, 1952). This hypothesis, too, does not find support in our data. The South Indians eat largely seed oils containing as much as 45 per cent poly-unsaturated fatty acids, whereas ghee and other milk fats eaten by the Punjabis contain only 2 per cent poly-unsaturated fatty acids.

Singh and Prakash (1964) make an interesting observation, which lends indirect support to our conclusions, that 13–14 years ago it was a curiosity to see a case of ischæmic heart disease in the general medical wards in hospitals in Patiala (Punjab) and that this observation is of special significance when it is remembered that consumption of milk and animal fats has diminished considerably in the Punjab since its partition in 1947.

Apart from the total quantities of fats and the character of fatty acids, there are several other contrasting features between the diets of North Indians versus South Indians which may be relevant to the difference in the incidence rates of acute myocardial infarction in these disparate groups. One such is the preponderance of short-chain fatty acid triglycerides in the diets of the Punjabis as compared with the South Indians. Experiments by many investigators suggest that the length of chain of fatty acids determines the route of absorption. Short-chain fatty acids are absorbed "directly" into the portal system (Hughes and Wimmer, 1935; Kiyasu, Bloom, and Chaikaff, 1952), whereas the long-chain fatty acid triglycerides have an absolute dependence upon hydrolysis with bile salts for their digestion into free fatty acids and glycerol, which are then re-synthesized in the wall of the intestines into complex triglycerides partly characteristic of the species (Davidson and Passmore, 1963).

Borgström, Tryding, and Westöö (1957) have unequivocally demonstrated that some 10 per cent of absorbed fat was absorbed as triglyceride, some 40 per cent was completely hydrolysed, while the remainder was only partly hydrolysed.

The cellulose and fibre content also shows big differences between the diets of the North versus the South Indians, and this may be significant because of the protective role ascribed by Walker and Arvidsson (1954) to roughage and fibre. Its mode of action is not clear. In view of the evidence presented by Popják, French and Folley (1951) that cellulose fermentation liberates large quantities of acetic acid in the gut, it appears likely that cellulose and fibre content of diet will also favour a preponderance of short-chain fatty acids in the plasma,

because acetic acid is the precursor of short-chain fatty acids. Such a possibility is also suggested by the studies of Lough, Garton and Duncan (1957) who showed a preponderance of short-chain fatty acids in the plasma of ruminants, and of Ahrens *et al.* (1958) who found in isocaloric feeding experiments that there was a preponderance of short-chain fatty acids in the plasma of a patient when his sole dietary fats were butter in contrast to corn oil. These results would indicate that if there is a preponderance of short-chain fatty acids in the dietary fats, the same will be reflected in the fatty acids of the plasma triglycerides (Ahrens *et al.*, 1958).

Another important and contrasting feature of the diets of the North and South Indians is the subdivision of the fat globules as a result of the methods of cooking, in the case of the former as compared with the latter. This too may be expected to produce the same result in view of the evidence that direct absorption is favoured to absorption after undergoing hydrolysis, if the fat globules are finely emulsified (Frazer, 1954; Daniel *et al.*, 1951).

Significantly lower amounts of bile in the intestinal lumen in North Indians, as compared with the South Indians reported elsewhere (Malhotra, 1967b, c), are likely to increase this contrast between the route of absorption of fats because, as experimental evidence produced by Dawson and Saunders (1965) shows, an absence or deficiency of bile from the intestinal lumen favours direct absorption of fats. Further, Kern and Borgström (1965) showed that the rate of intestinal absorption of fats was directly related to the amount of bile salts in the intestinal lumen.

It would be a reasonable assumption to make, therefore, that the pattern of diets, the methods of cooking, and the manner of eating give rise to a preponderance of short-chain or small particle, directly absorbed fatty acid triglycerides in the blood of the North Indians as compared with the South Indians, who would, on the other hand, have a preponderance of long-chain, complex fatty acid triglycerides partly characteristic of the species.

Since thrombosis is facilitated by long-chain saturated fatty acids (*Lancet*, 1964), especially fatty acids with not less than 16 carbon atoms which enhance thrombosis; and short-chain (C6–C7) saturated fatty acids produce virtually no enhancement (Connor and Poole, 1961); and because of the evidence from several others (Boyles, 1959) that the particle-size of fat in solution influences blood coagulation, it is interesting to speculate whether the postulated differences in the particle size and the chain-length of fatty acid triglycerides in the plasma of our disparate populations are responsible for the disparate frequencies of acute myocardial infarction among them. Because of the evidence that the triglyceride acids approached the fatty acid composition of the fed fats (Ahrens *et al.*, 1958), the importance of the pattern of diet and eating is of obvious concern, and seems to be a potentially fruitful area for further study in groups with disparate incidence rates of the disease and differing patterns of diet and habits of eating.

Summary

A survey of the incidence of acute myocardial infarction and the dietary behaviour in railway populations in India showed that the disease was 7 times more common among South Indians as compared with the Punjabis in the North, even though the fat intake of Punjabis was 8–19 times more than that of South Indians, and was chiefly of animal origin. Other differences in the pattern of diet and eating, rather than the amount and type of fats eaten, are important, e.g. the chain-length of the dietary fatty acids, the size of the fat globules, the roughage and cellulose content, and the patterns of cooking and eating foods.

The big differences in the incidence rates of acute myocardial infarction between the South Indians and the Punjabis are probably due to the fact that the fatty acid composition of fed fats affects the relative proportion of short-chain versus long-chain fatty acids in the plasma, which in turn influences the dynamic balance between blood coagulation and fibrinolytic enzyme systems. The possible role of the differences in the particle size of dietary fat is also discussed.

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