The geography of chronic digestive disease in southern Africa

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Summary

Lifestyle and dietary patterns are in the process of rapid transformation in Soweto. Comparisons with whites indicate differences in bowel behaviour, lactase deficiency and breath methanes.

The association between smoking pipe tobacco and cancer of the oesophagus is confirmed, but home-brew consumption has been found to be the major risk factor in this cancer. A recent swing to Western-type alcohol has led to the emergence of alcohol-induced pancreatitis in blacks. Urbanisation and westernisation have also affected the influence of the traditional healer and the incidence of duodenal ulcer disease.

The fundamental environmental influence which determines non-infective large-bowel disease is diet. A dietary survey of Sowetans indicates that their present diet is low in fat and fibre. Despite the latter, appendicitis is still relatively uncommon. Other significant differences are observed in colorectal cancer and diverticular disease.

The paths that lead to the discovery of the causes of disease are often long and tortuous, including along the way clinical impression, vital statistics, and a wide range of epidemiological and laboratory investigations. They may begin in physiological experiments, theoretical deductions, or serendipity, but they have often also started from a simple count of patients and description of where, when and how they lived. Such studies of the geography of disease, or geographical pathology as it tended to be called on the continent of Europe, were one of the principal means by which clues to aetiology were obtained in the last century, and led to the discovery of the causes of many parasitic and infectious diseases, of vitamin and trace element deficiencies, of chronic intoxications like ergotism, and of cancers of the buccal cavity in SE Asia, and the skin of the abdomen in Nepal.

Now, however, with the development of such refined and powerful tools as the electron microscope, the mass spectrometer, and DNA probes, we turn naturally to laboratory investigation as our method of choice and the value of simple observational studies tends to be overlooked. This, I believe, is a mistake. The world has not yet become a uniform unit; culture, standards of living and external environments vary greatly; and knowledge of the geographical distribution of disease is still far from complete.

A unique situation exists in Johannesburg. The black population of Soweto, numbering approximately 2,5 million, represents a coalescence of a divergent and rapidly changing society. It consists of immigrants who have been resident for up to 50 years, migrants who return each year to their families in the rural areas for varying periods, and the sophisticated urban born and bred people. In this kaleidoscopic milieu, lifestyles and dietary patterns are in the process of rapid transformation.

Juxtaposed to, yet separate from, this black community is a white population whose disease patterns are typical of those encountered in Western societies. There is thus a unique biological field laboratory where emerging diseases in the black population can be compared with the 'control' of an established Western society.

Soweto is served by Baragwanath Hospital. This hospital, with approximately 2 800 beds, is the largest on the African continent and in the southern hemisphere. The total number of admissions per year (1982) was 123 000 while the outpatient (including polyclinics) attendance was over 1 600 000.

Differences in certain physiological characteristics between white and black populations

Bowel behaviour

Burkitt, Walker, Trowell and Cleave were among the first to observe that there were major differences in bowel function between whites and blacks, and that these differences may account in part for the paucity of non-infective intestinal disease in blacks.

Compared with whites, blacks: (i) defecate more frequently; (ii) void a much higher proportion of semiformed or unformed stools; (iii) have shorter transit times; (iv) have pH values of their faeces significantly more acid than those of whites; and (v) have a greater surface area of the colon than whites. All these features may be important in the low incidence of 'Western' large-bowel diseases in the black population.

Lactase deficiency in the black population

It has been suggested that a factor which may lower the pH value in the colon, because of malabsorption of milk, is lactase deficiency. Lactase deficiency is common (78%) in the black population despite the fact that two of the largest groups (Zulu and Xhosa) were traditionally cattle herders and milk drinkers. This apparent anomaly is because they consumed a traditional fermented buttermilk (amasi), which has a low lactose content, instead of fresh milk. The most important reason for lactase deficiency, however, is that Southern African blacks originated in the West African and Central African zone where people do not milk cattle, and took up dairying and milk use fairly recently. Thus they have not had enough time to develop genetic selection for lactase.

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Accepted 2 Dec 1987.
Breath methane and bowel disease risk in contrasting populations

Appreciable differences in the proportion of subjects with detectable methane in breath were found in four local populations who experienced widely different risks of bowel cancer and other colonic diseases. The use of alcohol and tobacco in these regions. A unifying hypothesis to explain the regional differences is that dietary deficiencies - a low intake of animal protein, vitamin A, vitamin C and riboflavin - are the common denominator and are believed to provide an explanation for the epidemiology. During 1985-1986 a case control study of 201 oesophageal cancer patients and 392 hospital controls was carried out in order to determine risk factors in the Sowetan population. The results (unpublished data) indicated that the cancer patients were urbanised and came from a very low socio-economic group. In contrast with findings in previous South African studies smoking, although associated with cancer of the oesophagus, was found not to be the major risk factor. However, 41.7% of the cancer patients smoked cigarettes using pipe tobacco rolled in newspaper, brown paper or telephone-directory paper (controls 9.8%; \( P < 0.0001 \)). Home-brewed alcohol consumption was found to be the major risk factor (86%) (controls 55.1%; \( P < 0.0001 \)). The vast majority (92.5%) used maize meal for home brew production (controls 76.25%; \( P < 0.0001 \)). In 1972 Cook proposed a hypothesis that both the geographical and temporal distribution of cancer of the oesophagus in Africa could reflect the use of maize as a major ingredient of alcoholic drinks. The traditional alcoholic drink of South African blacks is a beer of low alcohol content (± 3%) made from malted sorghum and a starchy adjunct - sorghum grain or maize. In fact, maize was an ingredient of beer even before the turn of the century. It would thus seem that although there is evidence for a geographical association between maize in beer and cancer of the oesophagus, the temporal distribution does not coincide since oesophageal cancer first became a major problem in fairly recent times (1950s) while maize was used for beer making before 1900. An important phenomenon, however, is that the percentage of maize used in beer has increased considerably in recent times.

A typical recipe given by Oxford in 1926 showed that beer contained 28% maize meal. However, in 1964 56% of the content was derived from maize. The use of maize instead of sorghum grain has resulted in a decrease in the thiamine, niacin and riboflavin content of traditional brews. This would have dramatic effects on the vitamin B status of people such as the oesophageal cancer patients, who consume large quantities of beer.

This study thus supports Cook's hypothesis that both the geographical and temporal distributions in Africa reflect the use of maize as a major ingredient of alcoholic drinks with the use of maize being responsible for the dietary deficiencies in a group of people who consume large quantities of beer.

Alcohol-induced pancreatitis

Home brew consumption, as discussed above, is associated with oesophageal cancer. It is paradoxical, however, that the swing to Western-type alcohol in a large segment of the black population has led to the emergence of alcohol-induced pancreatitis.

Pancreatitis, a disease unknown among South African blacks in the 1920s, has recently emerged as a common clinical problem. Beyer's in a review of surgical diseases seen in Johannesbarg during the 5-year period 1921-1926, stated that no cases of pancreatitis were observed in blacks. Thirty years ago Keeley, in a review of gastro-intestinal disease at Baragwanath Hospital, reported that 'acute pancreatitis although frequently sought for is extremely rare'. Recent anecdotal reports indicated a change and we reviewed 70 cases of acute alcohol-induced pancreatitis in 90 cases of chronic calcific pancreatitis (CCP). The emergence of pancreatitis has taken place with a change in the pattern of alcohol consumption.

Before its repeal in 1962, legislation forbade the sale of Western-type alcohol to blacks and as a result alcohol was consumed in the form of traditional home brews with a low alcohol content. Once blacks were allowed to purchase Western-type alcohol there was a change in drinking habits. Western-type spirits in addition to home brews became part of the drinking pattern. Evidence for consumption of traditional home brews is iron overload. The majority of adult men in southern Africa showed varying degrees of tissue siderosis. In 1950 Walker and Arvidsson demonstrated conclusively that the excess iron was obtained from the diet and was mainly a result of the uptake of the element from iron utensils used during the preparation of fermented alcoholic beverages. Because of the change in drinking habits there has been a reduction in both the prevalence and severity of iron overload in urban South African black men over the past 20 years.

Additional evidence for the change in drinking habits in blacks is the alteration in the manifestation of liver disease. Micronodular cirrhosis associated with iron overload is characterised by the presence of large quantities of haemosiderin and there is no fatty change, alcoholic hepatitis, alcoholic hyalin or alcoholic cirrhosis. This contrasts with the presentation of micronodular cirrhosis observed in Western societies after prolonged consumption of spirits. Micronodular cirrhosis with fatty change, alcoholic hyalin, alcoholic hepatitis and alcoholic cirrhosis has now appeared in the black population. CCP in blacks has had devastating effects on morbidity, a mortality of 15% and a high incidence of complications. Most patients do not stop drinking and compliance with treatment is poor.

It is significant that CCP in South African blacks is characterised by features which are common to both the tropical and Western types. It must be emphasised, however, that alcohol is the decisive factor in the pathogenesis of CCP. It is further clear that a high carbohydrate, low animal fat, low protein diet merely modifies the clinical presentation and does not appear to be a significant factor in the pathogenesis of CCP in the South African black population.

Impact of urbanisation on traditional healing and duodenal ulcer

Besides changes in alcohol consumption patterns, westernisation
and urbanisation have other widespread sociological ramifications. This is evident in the influence of the traditional healer and the impact on duodenal ulcer disease.

Influence of the traditional healer

Urbanisation may have bizarre manifestations. This is reflected in the attempt of the urban black to retain vestiges of traditional healing. For effecting a cure the traditional healer uses enemas and emetics more commonly than other forms of treatment. They are 'prescribed' for ritual purposes, as an aperient, as an aphrodisiac, and for the treatment of gastrointestinal disturbances, dysmenorrhoea and impotence.

In the city use and abuse of emetics and enemas can result in damage to almost the entire gastro-intestinal tract. In particular, use of enemas containing substances such as vinegar, soap, potassium permanganate, diesel oil and brown sugar can result in ritual enema-induced colitis. It must be added that most of these substances are taken by patients themselves and not given by a traditional healer.

Duodenal ulcer disease

The classic pattern of the emergence of a disease and its development into a major gastro-intestinal problem is reflected in the pattern of duodenal ulcer in the Johannesburg black population. There has been a steady increase in the occurrence of the disease over the past 50 years. A specific characteristic of duodenal ulcer in Johannesburg blacks is that complications are similar to those found in Western countries. Thus haemorrhage and perforation are the major complications, whereas gastric outlet obstruction is relatively uncommon. However, in rural non-westernised areas of Africa with a high prevalence of duodenal ulcer such as Ghana and western Nigeria, the major complication is gastric outlet obstruction, resulting from a stenosing type of ulcer. This denotes that the 'Western' duodenal ulcer as observed in Johannesburg is different from the type of duodenal ulcer that occurs in rural areas of Africa. In addition, genetic studies have shown that, as in Western populations, duodenal ulcer patients are mostly blood group O, and non-secretors.

Susser and Stein postulated that the process of adaptation to urban life is important in the genesis of duodenal ulcer. During the Industrial Revolution in Britain there was a sudden very high incidence of duodenal ulcers, which occurred mainly in young men of upper socio-economic classes. Studies at Baragwanath Hospital in 1976 and 1986 showed that duodenal ulcer patients were mainly young men who were more likely to have been born in an urban area than controls, and were from a higher educational and occupational category than controls. It is thus postulated that upward mobility into the higher ranks of the working class is a critical sociological factor associated with duodenal ulcer. It should be noted that the above studies differ from the Durban experience.

Dietary survey of Soweto

The fundamental environmental influence which determines non-infective large-bowel disease is diet, particularly its fibre content. A dietary survey of Soweto was carried out in 1985-1986 to determine the effects of urbanisation on dietary patterns.

In rural areas the consumption of a low fat (10-15% of energy), high fibre (25-35 g) diet was and still is usual. We found a higher mean proportion of fat in the present study (24% of energy - 46 g daily). This has certainly increased with urbanisation, but is still significantly less than that of whites. The intake of saturated fat (9% of energy - 17 g daily) is also low (whites 26 g daily). There has been a dramatic decrease in mean dietary fibre intake to about 13 g daily. In the past in rural areas it was 40-50 g daily. Thus the salient features of the present diet of urban blacks is a low fat and a low fibre intake.

A puzzling feature is why non-infective bowel diseases have failed to increase markedly. World War II caused the national diets of some Western nations to be altered in pattern. The fat intake fell slightly, yet the fibre intake rose considerably. These changes were propitious for a decrease in the frequency of appendicitis and diverticular disease. Morbidity and mortality rates of diabetes and coronary heart disease also fell. The decreases in the incidence of these diseases were associated with dietary changes that only lasted a few years. The frequency of the occurrence of these diseases rose when war-time diets reverted to their former high-fat, low-fibre pattern.

How valid is the dietary-fibre hypothesis in respect of the chronic bowel disease and disorders mentioned?

On the basis of experimental studies on animals, some case-control studies and also the results of epidemiological observations it has been concluded that the most important dietary components which are implicated in occurrences of chronic bowel disease are levels of intakes of energy, fat and dietary fibre. There are, however, major limitations to the hypothesis.

1. When traditional diets are relatively low in energy and fat, and are high in dietary fibre, the rates of occurrence of bowel diseases are uniformly low — there are no exceptions, irrespective of the source and nature of the fibre (cereals, legumes, tubers or other foodstuffs).

2. With urbanisation and prosperity, when the level of energy intake increases, fat intake rises and fibre intake falls, the incidence of all bowel diseases increases, but in a varying manner. The conclusion is that with the changes described, factors other than levels of fibre intake come into play, such that the level of fibre intake may appear of no aetiological relevance.

3. When the dietary changes described become involuntarily reversed, as occurred in certain countries in war-time, some bowel diseases decreased, notably constipation and appendicitis. This phenomenon underlines the caution that must be exercised in overclaiming, overblaming or in the discarding of the diet-disease hypothesis.

Appendicitis

Appendicitis is the commonest of the abdominal emergencies in Western countries. In contrast, in developing populations, the frequency of the disease, although increasing slowly in some parts, is much lower. In black adolescents in South Africa the frequency of appendicectomy is only 5-10% of that in local whites of the same age. Also, the frequency of appendicitis in urban blacks in Johannesburg has scarcely risen over the last 30 years.

The most frequent obstructive factor in appendicitis is faecoliths. Jones et al. have postulated that faecoliths develop more readily in people who consume a diet deficient in fibre and in a collaborative study with a Toronto hospital reported: (i) prevalence of faecoliths in patients whose appendices were palpated incidentally during laparotomy for indications other than appendicitis — South African blacks 4%, Canadian population 32%; and (ii) prevalence of faecoliths in patients with appendicitis — South African blacks 23%, Canadian population 52% (P < 0.005). There are thus two enigmas — faecoliths are uncommon in the black population, and much less common in blacks with appendicitis than in westernized people with appendicitis, and despite a dramatic drop in fibre intake, the incidence of appendicitis has not increased significantly (contrary to World War II experiences).
Colorectal cancer

Colorectal cancer is the second most common cancer in many Western countries. It is uncommon, however, in the black population and colorectal polyps are rare. In the Johannesburg white population the incidence of polyps and colorectal cancer is similar to that in Western countries, as is the sex ratio, site distribution and incidence of co-existing adenomatous polyps. Examination of apparently 'normal mucosa' in black patients with large-bowel cancer has shown the presence of flat mucosal lesions in which dysplasia of epithelium is present. It is possible that these flat mucosal lesions (or intramucosal adenomas) progress to cancer without initially developing into polyps. There seems little doubt that the pattern of cancer development in Western populations is for preformed adenomas to develop into colorectal cancer. Thus the classic adenoma-carcinoma sequence observed in Western countries may not be relevant to the development of all colorectal cancers in Third World communities.

Diverticular disease

The geographical distribution of diverticular disease is intriguing. In Oriental people there is a predominance of right-sided diverticulosis in African blacks, in whom the disease is very common, the site of predilection is the descending colon, while in Western populations the sigmoid colon is most commonly affected. Painter’s hypothesis of fibre deficiency causing viscous stools, leading to excessive segmentation generating very high localised pressures and thus producing diverticula, is consistent with the sigmoid being the commonest site in Western nations.

Facetal contents are, however, fluid in the right colon and this is consistent with Painter’s hypothesis. The variable anatomical distribution therefore suggests that diverticular disease comprises more than one entity with different causes.

Conclusions

I have illustrated some of the findings relevant to geographical disease distribution in a developing country. In this context it should be realised that urbanisation is proceeding at a high rate in Third-World countries. It is predicted that by the year 2025 more than half the people of Africa and Asia will be living in cities. This is particularly significant considering how overwhelmingly rural these continents have been up to now. Unfortunately, because of the impoverished state in which most of these countries find themselves today, it is probable that urbanisation will take place in a chaotic manner and that urban areas are likely to remain poor. The situation provides us with both a formidable challenge and a unique opportunity — a challenge to promote health and longevity by preventing the catastrophic effects of infections such as gastroenteritis and deficiency diseases which already haunt our turbulent continent, and an opportunity to study Western diseases as they emerge from the chrysalis of early urbanisation.

In terms of the geography of disease and medical research it is well to reflect on the words of that controversial and visionary statesman, Cecil John Rhodes, as he pointed north: ‘Your hinterland lies there’ — a particularly pertinent comment for all of us who work in Africa.

REFERENCES

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