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Editorial

The Physiology and Pathology of Unusually High Intakes of Nutrients

In his summing up of the Conference on Protein Nutrition held in New York in 1957, Stare[1] referred to nutrient intakes which are minimum, optimum or excessive. Whereas much is known of the physiology and pathology of nutritional deficiencies, far less is known of the effects of habitually excessive intakes of nutrients. Experimentally, of course, much may be learned on this subject, but uncertainty over the extent by which findings may be extrapolated to man limits the value of animal studies. In this particular field enlightenment on many problems may be forthcoming from careful studies of certain African populations, primarily because of the gross diversity of diet which varies from one territory to another, and frequently within the same territory. Examples of some of these interesting situations follow.

Excessive consumption of protein and fat are found among nomadic tribes dwelling in Somaliland and Eritrea (northeast Africa) who, for much of the year, subsist largely on milk from goats and camels. Publications[2–4] indicate consumptions of 2.5, 4 and even up to 9 L. per day. On the basis of the composition of goats' milk (3.3 per cent protein, 4.8 per cent fat) these volumes supply protein and fat intakes of 83 gm. and 120 gm., 132 gm. and 192 gm., and 297 gm. and 432 gm., respectively, and provide about 25 to 50 per cent of the total calories. From the limited information provided, it does not appear that these excessively high intakes are deleterious, but obviously, comprehensive studies are urgently required. This is particularly the case with the high fat intake, which understandably touches on one of the most controversial questions in nutritional science at the present time. If the expected ramifications in blood lipids, arterial atherosclerosis, and ischaemic heart disease are not proved, it could be inferred that, contrary to a strong body of current opinion, a high intake of animal fat *per se* need not be harmful.

The physiology and pathology of excessive carbohydrate consumption, in the presence of low intakes of other nutrients, have been the subject of much inquiry. In very young children, the adverse picture is fairly well known and understood. At the same time, the ill effects of diets which are calorically satisfactory but habitually grossly high in carbohydrate, as among Africans whose staple foods are cassava, yams, plantains, etc., are less well known, and there is much uncertainty over interpretation of the prevailing stigmas. There is much the same insufficiency of knowledge in regard to the preponderant carbohydrate moiety in the diets of those who consume large quantities of cereal.

There is a high intake of crude fiber among Africans in numerous regions. This results,

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inter alia, in rapid passage of fecal material and in voluminous stools being voided more than once a day. It has been speculated that this high intake, directly and indirectly, has many ramifications in features as diverse as blood lipids,[5] the low incidence of eclampsia,[6] and the relatively low incidence of carcinoma of the large intestine.[7]

Low intakes of calcium are usual in African populations. But the nomadic groups in northeast Africa, already referred to,[2-4] consume several grams of calcium per day. Some of us have noted the low calcium intake of the Bantu, the relatively low levels of serum calcium,[8] the lesser severity of atherosclerosis and especially of aortic calcification, and the negligible mortality from coronary heart disease. Accordingly, we have wondered whether, of the numerous possible influencing factors, the much higher calcium intake of Western peoples is altogether innocuous.[9] Research on these nomadic groups at least would afford an answer as to whether or not a grossly high intake of calcium *per se* is deleterious.

The very high iron intake of the South African Bantu (as much as 100 to 200 mg. per day) and the remarkable phenomenon of siderosis (affecting as much as three-quarters of the adult population), together have been the subject of a number of publications.[10,11] Whether or not the excessively high iron intake (apparently decreasing in urban areas) is ultimately toxic is the object of much research but the interpretation of the results remain unsettled.

Certain Bantu groups are habitually high consumers of plant ashes or salt or both. Whether or not such intakes promote the hypertension so common among these people,[12] and share in the responsibility for the high mortality from cerebral vascular disease,[13] awaits investigation.

A number of isolated Bantu groups consume highly saline water, far higher in mineral content than orthodox limits for potability. Small communities at Kukong, in the South-central Kalahari Desert habitually and exclusively drink water of this type. No serious study has been made of possible ill effects. In certain of these regions the highly saline water, in addition, has a high concentration of fluorine.

Heavy consumers of palm wine, as among the Warri in Nigeria, have an excessive intake of vitamin A, far higher than the recommended dietary allowances.[14] The effects of this excessive intake are not known.

While the amount of vitamin D ingested by most African populations is negligible, that derived from exposure to radiation must be at least adequate, and presumably accounts for the rarity of rickets and osteomalacia among rural dwellers.[16] Calcification in groups who wear negligible clothing and who experience a plethora of sunlight has not been studied.

Consumption of fermented cereal preparations is widespread in Africa, resulting in high intakes of several components. Bantu workers at this Institute consume daily an average of about 2 L. sour porridge (*magou*) and 1.5 L. kaffir beer. The alcohol ingested may be 45 to 55 ml. per day, an intake higher than the 30 ml. average amount of alcohol ingested by the drinking population of the United States.[15] In such populations as the Bantu, the metabolic and pathologic ramifications of excessive alcohol ingestion (as well as of acidity, pH values are 3 to 4) are not known.

The foregoing examples, and many others which could be adduced, draw attention to a large area of nutritional science in which objective information is defective. It may be argued that such knowledge, even when secured, will refer primarily to the relevant dietary contexts studied, and that the direct application of such knowledge to Western dietary patterns will be unjustifiable. On the other hand, it may be countered that almost all if not all the situations cited bear directly or indirectly on subjects upon which there is much difference of opinion, e.g., the significance of very high protein feeding in kwashiorkor, high animal fat intake in ischaemic heart disease, excessive iron in idiopathic haemochromatosis and transfusional siderosis, high intakes of calcium and vitamin D in idiopathic hypercalcaemia of infants, excessive salt intake in hypertension and cerebral vascular disease, fluorine in relation to fluoridation of water supplies, and so forth. Careful study of the

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situations detailed cannot therefore be otherwise than highly rewarding. Not least will they tell us more of man's enormous capacity for dietary adaptation.

Appropriate regions for all these investigations, and for many other intriguing problems, as already indicated, are found readily in Africa, with and without other variables, e.g., stress from excessive heat and humidity, single and multiple parasitic infestions, progressive urbanisation, and so forth. But Africa is on the move, so to speak, and is no longer static. Vast forces of change are at work, the existence and operation of which imply that the nutritional situations described may no longer prevail a generation hence.

Obviously, these situations are far from being suitably exploited for much needed information. In diffidence, one looks askance at the huge research potential now being devoted to animal experimentation in most Western countries, with all the accompanying detail and minutia, when such wide fields of human nutrition are ripe for study, but remain unharvested.

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