

Perspectives in Nutrition

Problems in Nutritional Supplementation and Enrichment

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IT is hoped that *Perspectives in Nutrition* will review the literature selectively, interpret it moderately and present a spectrum of ideas that will serve as a continual stimulation to nutritional research applied to medical problems.

IN underdeveloped countries in which nutritional deficiency disease is often rife, the subject of supplementation and enrichment of food is a highly practical one. When the classic deficiency diseases and kwashiorkor are present, the choice of treatment presents no problem. However, when authorities resolve to safeguard against subclinical nutritional deficiency, the selection of the best and most economical prophylactic measures is often difficult. For example, the addition of small proportions of food supplements to a staple foodstuff to combat a widespread nutritional need, such as protein undernutrition in the young, upon more careful examination, may be shown to be of dubious value. Such a situation occurred recently in South Africa involving a 3 to 4 per cent premix composed of skim milk powder, defatted groundnut meal, fat and a calcium salt which, for several years, was incorporated in the brown bread meal (which constituted 25 to 30 per cent of total consumption). The addition, which cost about £750,000 annually, was discontinued in 1960 because it did not make a significant contribution against the deficiency conditions it was designed to prevent.

At the Fourth International Congress on Nutrition (1960), McHenry¹ cautioned that

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“our knowledge of nutritional requirements is far from precise and is, indeed, sketchy.” Therefore it is not surprising—and this is the burden of this paper—that the precise value of nutritional enrichment of diets is uncertain except when clinical stigmas are obvious. The crux of the problem lies in deciding at which state of need supplementation should begin. There are three main choices. Supplementation may be called for (1) when nutrient intake is less than the recommended allowances; (2) when biochemical values for various blood or urine components are below “normal” limits, and (3) when clinical stigmas are apparent. The yardstick to be used depends primarily on the economic situation of the population concerned. The more wealthy nations can afford national programs even when a specific need is only suspected and may regard them simply as measures required for maintenance of health. In contrast, poorer nations may not be able to institute supplementation practices until signs of a clinical deficiency actually appear.

There are three major types of supplementation: (1) supplementation in total populations with or without signs of clinical deficiency; (2) supplementation for normal physiologic processes, e.g., growth, pregnancy and lactation; and (3) supplementation necessitated by bacterial and parasitic infections. A fourth possibility is supplementation to offset the ill effects of luxur intakes of a particular nutrient, e.g., vegetable oil products to counteract the atherogenic effect of a diet high in saturated

fats. In the following paragraphs, these categories of supplementation will be exemplified and discussed.

SUPPLEMENTATION FOR TOTAL POPULATIONS

When Nutrient Intake is Less than Recommended Allowances, but Unequivocal Stigmas (Clinical, Pathologic or Biochemical) are Lacking

The addition of calcium carbonate to the staple bread meal practised since 1942 in Britain, is an example of such supplementation. Initially, the addition was introduced chiefly to counteract the alleged ill effects of phytic acid,² a danger still given credence.³ Also at that time, a large proportion of the population was not ingesting recommended amounts of calcium. Soon after World War II, the extraction rate of the bread meal was lowered virtually ending the phytic acid problem. However, the policy of adding a calcium salt was continued⁴ and now would seem to be wholly one of insurance, although insurance against which stigmas is not altogether apparent.⁵ At present, some justification for the addition might be provided if the belief of Nordin⁶ and other workers⁷ could be substantiated, namely, that the occurrence of osteoporosis in a proportion of the elderly people stems chiefly from insufficient ingestion of calcium.

When Nutrient Intake is Less than Recommended Allowances but, at Least Initially, Clinical and Other Stigmas are Present

The enrichment of staple bread flour with three B complex vitamins, practised in the United States since 1943, falls in this subdivision. At that time pellagra was common, especially in certain southern states.⁸ The addition of vitamins, combined with a considerable rise in the standard of living, the latter being perhaps the more important change, virtually has eliminated this deficiency disease.^{8,9} The continuation of such supplementation nationally now may be of questionable value,⁹ although as an insurance it may be warranted regionally.

A further example of enrichment of this type—in the presence of clinical stigmas—is the addition of thiamine to rice to combat endemic

beriberi in the Philippines.¹⁰ In this case, however, withdrawal of enrichment would lead to an increase in the incidence of the disease.

When Nutrient Intake is Deficient, and Clinically Detectable Stigmas Unaffected or Little Affected by Living Standards are Present

Examples of such supplementation are (1) addition of an iodine compound in regions in which intake of the element is low or in which goitrogenic foodstuffs are consumed, and (2) the addition of fluorine compounds to potable water where increased intake is considered beneficial to dental health. Adequate long-term follow-up investigations regarding such additions are incomplete.

SUPPLEMENTATION FOR PHYSIOLOGIC REASONS

When Nutrient Intake is Less than Recommended Allowances During Growth, and Clinical Stigmas are Rare or Common

There are several types of supplementation in this category: (1) Fish liver oil and other compounds high in vitamin D long have been used for the cure or prophylaxis of rickets. However, the precise relationship between the levels of vitamin D ingested, the vitamin D absorbed from radiation, and the occurrence and severity of rickets, is still undefined. (2) The use of fruit juice for children as a protection against scurvy is common practice. In Britain the provision began in 1941 and by 1943 included children up to five years of age.¹¹ In 1956 its value for older children was questioned; indeed the committee recommended that after their second birthday children should not be given orange juice because “the provision of orange juice for children of two to five years old would be an insurance against a contingency which the available evidence suggests does not exist.”¹¹ Despite the public's bewilderment and some sarcastic comments from the press, such evolutionary changes of policy are inevitable in the light of further research and practical experience. The minimum amount of vitamin C needed to protect young children from scurvy remains undefined. (3) The absence of protein of good biologic value is the primary deficiency in kwashiorkor. Various food mixtures have



been employed for its prophylaxis and therapy, and the endeavors of Scrimshaw¹² and Dean¹³ with their respective associates in Guatemala and Uganda are particularly noteworthy. Methods of assessing the nutritional value of milk products and their substitutes have given rise to much discussion;¹⁴ the number of publications of comprehensive long-term studies on the use of foodstuffs in treating those with protein deficiency (manifested clinically or otherwise) is still insufficient. (4) Underweight in growing children is associated with diets low in energy value and exacerbated by bacterial and parasitic infections. In underdeveloped populations, although underweight may be the rule, the magnitude of the problem usually precludes intervention until the condition is severe enough to warrant clinic or hospital treatment. Among westernized populations there is the converse situation in which the interpretation of "optimum" growth is colored by the popular, although highly questionable, belief that rapid growth is essentially meritorious.

When Nutrient Intake is Less than Recommended Allowances During Pregnancy and Lactation

The chief nutrients which are likely to be lower than the recommended allowances during pregnancy and lactation are protein, iron and calcium. (1) Earlier studies have indicated that the ingestion of additional protein during pregnancy conferred benefits in obstetrical performance and pediatric rating,^{15,16} but confirmation is lacking. The nutritional and physiologic adaptations that occur in pregnancy have recently been emphasized by Beaton;¹⁷ and Gopalan,¹⁸ from his experience in India, stressed that "while the malnutrition of the mothers subsisting on inadequate diets is understandable, what is intriguing is the fact that a large number of these mothers are able to go through pregnancy apparently normally and deliver normal infants of average birth weight." At present, it cannot be said with assurance that a pregnant woman, habituated to an intake of 55 gm. protein per day, will benefit detectably from an increase to 80 gm., as is usually recommended. (2) Routine administration of iron during pregnancy is a

common practice. In the recent World Health Organization report, "Iron Deficiency Anaemia,"¹⁹ it is stated that "pregnant women will derive great benefit from additional iron . . . once daily throughout pregnancy and the first six months of lactation." Others, however, consider that "No advantage has been demonstrated from raising the haemoglobin level in normal pregnancy, and there may be dangers."²⁰ In connection with these different views, a ticklish situation is presented by South African Bantu women, among whom intermittent high iron intake (mainly adventitious) is common. Because of the fall in hematologic values usually observed in pregnancy, routine prophylaxis is advocated. In hospitals with fixed budgets the question arises whether money should be spent on iron therapy for pregnant women, in whom the need for iron is dubious, or be used preferentially on items such as skim milk powder for Bantu infants convalescing from kwashiorkor. (3) All dietary standards recommend liberal increases of most nutrients during lactation. It has to be admitted, however, that the benefit to lactation from increases in the intake of protein (55 to 80 gm.) or calcium (0.6 to 1.5 gm.) in the diet of most western women during the suckling period is slight, if any, whereas mothers in underdeveloped areas without nutritional supplementation, usually fare far better in the lactation process.

SUPPLEMENTATION IN BACTERIAL OR PARASITIC CONDITIONS

This category includes therapy with nutrient supplements in patients with wasting diseases, e.g., tuberculosis, in malnutrition with gastroenteritis and iron deficiency anemia in hookworm infestation.

COMMENTS

What has been written is far from exhaustive and is an oversimplification of an immensely important subject. It must be remembered that recommended allowances of nutrients primarily are targets and do not imply that the ingestion of lesser amounts is necessarily inimical to health. Furthermore, the precise physiologic requirements of most nutrients remain unknown. Hence, as previously noted,



it is only when deficiency disease is detectable clinically that the value of nutritional supplementation is entirely beyond dispute. Thus, the present value of nationwide supplementation of calcium in Britain and of B complex vitamins in the United States remains to be established. The nutrient requirements for "optimum" growth must await the determination of just what is meant by "optimum" growth, which assuredly is not synonymous with maximum growth. Especially humbling is the inadequate knowledge of the efficacy of supplements in pregnancy and lactation.

It may be argued that the cost of almost all the supplementation mentioned is low, if not trifling, in comparison with the larger sums of money misspent by nations. However, the important point is that the cost of one nutritional addition may far exceed the entire amount spent on nutritional research.

It is neither contended that supplementation programs should be suspended immediately, when evidence of nutritional improvement is not wholly convincing, nor doubted that benefit is conferred at least on some consumers. It is maintained, however, that some of the current programs require critical reassessment and that far reaching or costly programs should be initiated only after carefully controlled pilot studies have been undertaken.

SUMMARY

There is no lack of knowledge on the effective treatment of classic and other clinically detectable deficiency diseases. However, under conditions of lesser deprivation, whether real or suspected, the problem of which worthwhile ameliorative measures to implement within the resources available, is a profound one. Consideration of a number of examples of supplementation and enrichment now being practised in different parts of the world indicates that the nutritional benefit derived from them requires re-evaluation.

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