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Feeding Trials in Children

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The Protein Advisory Group of the United Nations agencies is developing a document with "suggestions for the design and execution of field studies to evaluate measures for improving protein nutritional status," a sort of Guide Michelin for the nutritionist about to embark on such a tour. Until it becomes available, I would strongly recommend the elegant critique of their own field study published by Béhar, Scrimshaw, Guzmán, and Gordon in the November 1968 issue of *Archives of Environmental Health*. I note in the January 1969 issue of *Archives of Environmental Health*, in the ninth paper of the series on "Nutrition and Infection Field Study in Guatemalan Villages," that Scrimshaw, Béhar, Guzmán, and Gordon indicate that their group has embarked on additional field studies of the effects of nutrition inputs.

Although the above-mentioned study failed to produce the desired proof of the value of supplementary foods in a field situation, it did provide a wealth of additional valuable information, and a healthy respect for all the variables which might affect the results of such studies. It would be foolish indeed for anyone to embark on a similar venture without reading the entire series of papers from the INCAP group.

In 1962 we embarked, in Peru, on a five-year study of the effect of dietary supplementation on the growth of children in a relatively poor rural environment. We felt quite smug because our four populations, two supplemented and two controls, were more nearly equal than INCAP's, and despite relative isolation from each other were tied to the same larger and very stable socio-economic unit. Our food distribution scheme was also to be simpler, more economical, and more likely to be effective, a sort of "Europe on five dollars a day." In the June 1970 issue of the *American Journal of Clinical Nutrition* we have reported the major part of our results. Fig. 1, from that paper, reveals that at the end of the first year there seemed to be a significant improvement in the growth of preschool children in the supplemented populations, our target group. We should have quit then: during the following four years our control populations made similar gains. We have a number of possible explanations, none measurable. Table 1, from the

same paper, however, reveals that there was a very suggestive drop in the mortality of infants and preschool children in the supplemented groups. Not included in that report is evidence of a drop in the incidence of overt malnutrition, and an apparent increase after the supplementation was discontinued.

Just as the INCAP group did, we took a number of interesting side trips, including the creation of a feeding station for preschool children. If nothing else, this helped explain the disappointing effects on growth. We learned a great deal about attitudes toward food, about its withdrawal at the slightest provocation, about the frequency with which minor illnesses interfere with intake, and about the difficulties the poor encounter in preparing and consuming meals. We also reaffirmed the observation that it is total effective calorie intake over a long period that determines rates of cellular multiplication and somatic growth. Protein quantity and quality, as well as an adequate supply of minerals and vitamins, are more vital to the health of the whole organism and its individual cells. From this and other studies in urban populations we are convinced that reduced rates of growth are an important part of the adaptation to a hostile environment, and that for these to be changed the whole environment must be up-graded.

From these experiences as well as those of others, we are convinced that if the introduction of new and supplementary foods must await field proof of their effectiveness in improving the growth of children, no action will ever be taken and the entire nutrition community will justifiably be cursed by the world's needy people and by history.

It should be useful to examine the actions taken by a highly developed and wealthy nation in coping with its own nutrition problems. Following sensationalistic disclosures of so-called widespread starvation and malnutrition in this country, a national conference on the subject was convened. Upon reading its preliminary recommendations the executive director of the National Council on Hunger and Malnutrition in the U.S. remarked: "The main criticism relates to the switch in the conference focus—veering sharply away from the problems of feeding the poor to the problems of the professionals. The recommendations we have seen

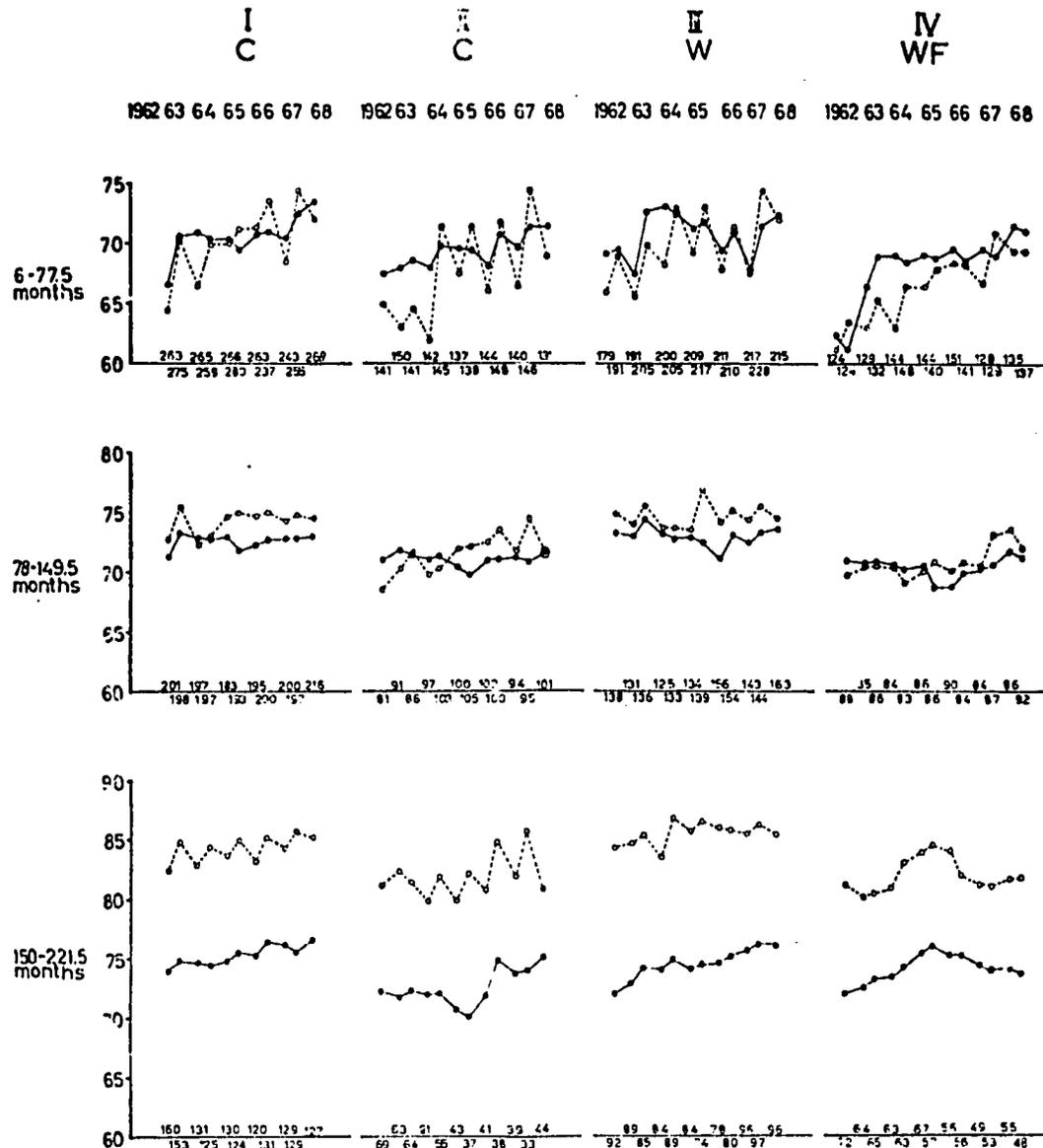


FIG. 1. Mean developmental quotients for height (closed circles, solid lines) and weight (open circles, broken lines) of all boys and girls in each age category at the time of each semiannual measurement in each of four populations: I and II

were controls (C), III received wheat (W), and IV received wheat and fish (WF) supplements. Figures along the baselines indicate the number of children measured each time.

seem aimed more at guaranteeing job protection for the nutritionist, the dietitian, and the doctor than they are toward guaranteeing an income for the poor." He also deplored the emphasis on nutritional education, labeling it "the last refuge of the nutritional conservative." Although I doubt that income support will do much for the nutrition of those in the U.S. who are indeed undernourished, I think we should pay heed to the above criticisms, lest we be

accused of adding epidemiologists and statisticians to the list of those whose jobs are being secured.

We have spent the past decade in training nutritionists from underdeveloped countries and then sending them home with a pat on the back and cookbook instructions for developing their own "indigenous food mixtures" and determining their PER's in rats, the only ones who will ever consume most of them. Some of these

TABLE 1. Infant (0-12 months) and pre-school child (12-60 months) mortalities in four populations during the 12 years preceding the study and during the 6 years (1962-67) of supplementation of populations III and IV.

Age group	Years	Populations				"P" values			
		I	II	III	IV	I-III	I-IV	II-III	II-IV
Deaths/1000 inhabitants									
0-12 months	1950-61	8.2±2.4	6.1±4.9	5.0±3.2	7.0±3.7	<0.02	N.S.	N.S.	N.S.
	1962-67	5.2±1.9	8.3±3.7	2.0±1.1	2.5±1.4	<0.01	<0.02	<0.01	<0.01
	"p"	<0.05	N.S.	<0.05	<0.02				
12-60 months	1950-61	5.3±3.6	3.3±3.3	4.0±2.6	3.5±3.3	N.S.	N.S.	N.S.	N.S.
	1962-67	2.3±1.9	1.8±2.3	0.7±0.6	1.3±1.1	<0.1	N.S.	N.S.	N.S.
	"p"	N.S.	N.S.	<0.01	N.S.				
Deaths/1000 births									
0-12 months	1962-67	104±37	165±95	44±25	52±32	<0.01	<0.05	<0.02	<0.05
12-60 months	1962-67	46±39	54±39	17±13	26±21	N.S.	N.S.	N.S.	N.S.

recommendations have apparently leaked out, for we recently heard a demand for inclusion of the PER on the labels of dry cereals marketed in this country. I doubt very much that rats can read and make the proper choice.

It would be tragic to see another ten years spent in long and expensive field trials before any action is begun. We might again examine what has happened in this country. Faced with enormous pressures, much of it from some of the same nutritionists who demand field trials elsewhere, we have embarked on a massive

expansion of food distribution, particularly school lunch programs. This summer, through the same logic, these last have been extended through the vacation months, with food distribution for children in target areas. Fig. 2 illustrates one of the consequences. There was never any question in the minds of most experts as to which foods should make up these lunches, for the "basic four" had been legislated into the programs. And there certainly have been no field trials to prove their effectiveness. If it were not for a few concerned individuals

Children Feed Trash Cans With Unwanted Free Foods

By KATHY KRAUS

Dozens of youngsters lined up outside the Operation Champ office in West Baltimore yesterday waiting for free lunches to be distributed. baskets were piled high with unopened containers of German potato salad, still-cold cartons of milk, uneaten ham sandwiches and crisp apples.

Shortly afterward, across the street As city health and poverty of-

Fig. 2. From The Baltimore Sun, August 7, 1970.

TABLE 2. Nutrients compared in three foods.

	Human milk 750 ml	Cow milk 750 ml	PB&J ^a	PB&J ^a plus ^b	% RDA 9 yr.
Kcal	562	517	525	525	25
Protein (g)	8.2	24.7	14.0	17.6	44
Fat (g)	33.7	27.7	26.9	26.9	
CHO (g)	51.0	36.0	61.3	57.7	
Ca (mg)	255	937	80	80	10
P (mg)	105	720	199	199	20
Fe (mg)	0.22	0.75	2.7	3.7	37
A (IU)	1423	768	332	332	9.5
B ₁ (mg)	0.12	0.33	0.19	0.29	26.4
B ₂ (mg)	0.27	1.30	0.18	0.25	20.9
Niacin (mg)	1.10	0.70	6.55	7.36	49
C (mg)	31.0	8.2	1.4	1.4	3.5

^aBread 61, butter 10, peanut butter 32, jelly 35 g.

^bHigh protein flour and double the usual fortification.

there might not even be an attempt to evaluate the effectiveness of these massive programs. We have trained generations of nutritionists, dietitians, home economists, and school teachers on the virtues of a balanced diet from natural sources. Most members of the nutrition "establishment," brought up with these concepts and with eating habits that date back many centuries, cannot begin to understand why they and their teachings have not met with universal success.

To expect the poor, the elderly, or just the very busy to purchase regularly, at a high price, the proper balance of fresh foods, to prepare them in a way which conserves their nutritive value, to consume them in the traditional pattern of three meals, and, last but not least, to clean up afterward, is in reality as ridiculous as if we had all come together here by sailboat and on horseback. And yet this is the substance of many of the recommendations made: to train enough dietitians and home economists who will lead the people by the hand toward proper practices in the buying, preparation, and consumption of food. School lunch and other feeding programs flounder in the mechanics and the cost of their execution because of this insistence on traditional meals, particularly "hot meals." The "still-cold" cartons of milk in Baltimore trash cans, and in those of most of our school cafeterias, are silent and expensive witnesses in this country to the same physiologic truth which for years has accounted for the rejection and misuse of powdered milk by many underfed groups. Traditionally attributed to ignorance and lack of hygiene, we are now beginning to realize the

magnitude of lactose intolerance throughout the world, particularly in non-white populations. Yet cow's milk is the only beverage and the main source of protein, minerals, and vitamins in our school-lunch programs and in many mass feeding programs. It comes very hard to most of the nutrition establishment to realize that the most valuable of foods for one group of people is intolerable to other groups.

Children the world over have a decided preference for simple foods and could not care less whether they are cold or hot: what matters is ease of consumption; not having to battle with the clumsy eating utensils of their ancestors; and taste, texture, and the ability to satisfy their appetite. To most children, salads are for rabbits, most vegetables 'for the birds,' spinach an abomination, and even fresh fruit often considered a 'drag.' Meat, unless it is ground up, is a 'bore.' Most mothers, and our experts as well, are appalled at their children's desire and willingness to consume, day after day, that most popular of all U.S. foods: the peanut butter and jelly sandwich, or the PBJ, as many children call it. Table 2 looks at the nutrient contribution of this infamous food. The first column lists the nutrients in 750 ml of human breast milk, the next column the nutrients in 750 ml (three glasses) of cow's milk. The third column lists the same nutrients in a typical peanut butter and jelly sandwich, made with ordinary white flour, as presently fortified with iron and vitamins. The fourth column shows a PBJ made with a high-protein flour, the result of air classification, and with double the usual fortification. The last column lists the percentage of the recommended dietary allowances for boys

of 8 to 10 years that would be provided by one such sandwich. If synthetic lysine is added to the flour, along with more calcium and trace minerals, and if vitamins A and D are added to the peanut butter, and vitamin C to the jelly, all without changing the characteristics of the sandwich, it becomes an even more impressive meal than it already is.

The food preferences of our children, like those of nearly all people, generally have a sound basis. They are eating a simple and very nutritious cereal, wheat in this case, reinforced with a rich source of protein and of appetite and energy-satisfying fat, along with a further source of energy and taste. The final product is ridiculously simple to prepare, store, transport, and consume, and leaves no waste. It is highly nutritious, extremely acceptable, inexpensive, and in the sound tradition of rice and beans, tortillas and beans, rice and fish, pasta and cheese, and many other traditional foods. When cereals, the source of well over half of the world's protein and calories, are publicly downgraded by nutritional illiterates and others who should know better, a tragic wrong is committed. I would dare to venture that if a fully fortified peanut butter and jelly sandwich, with a soft drink, were offered as an alternative to the hot meals now provided in school lunches well over 50% of children would select them and get better nutrition at a much lower cost. There are now available completely balanced meal beverages, as well as nutritionally complete pasta products which can serve the same purpose. I do not doubt that the combined efforts of the nutritionists and food technologists here represented can come up with countless fortified versions of traditional foods which could serve the same purpose in different parts of the world. I suspect that bread will always be high on the list of such items.

Only yesterday I was delighted to learn that the U.S.D.A. and O.E.O. were supporting studies at Rutgers University of various types of food delivery systems and their effectiveness. This study will also develop and test nutritionally engineered foods to evaluate their merits and acceptability for school food service. They are looking at such foods as bakery products, which, when combined with a glass of milk, make up a complete breakfast; at protein-and-vitamin-fortified macaronis; at textured vegetable protein foods; and at fortified peanut butters.

It is reasonable and understandable that responsible authorities should be concerned with the effectiveness of programs that might consume limited individual and national resources.

It is unfortunate, however, if such concern leads to fear of decision-making and further paralysis of action. Surely there is a happy meeting-ground between total inaction and programs conceived in hasty response to political pressure, with little concern for their ability to reach those in need.

One of the few nutritional problems of wide significance in this country is that of iron-deficiency anemia in infants and children between 6 months and 2 years of age. It has been proposed that we "solve" it by even further iron fortification of cereals. Should we proceed pell-mell with such a measure, or should we, for instance, await the results of a five-year field trial in Baltimore, leaving Washington as a control? It is almost certain that neither of these alternatives represents the proper course. By the time the five years are up, it is almost certain that innumerable variables would have completely confounded the "results." It is hoped that before this time the knowledge would have been disseminated that probably half the cases of "iron-deficiency" anemia in this age group are the result of blood loss into the intestine caused by the feeding of pasteurized but un-boiled milk to small infants, and that it can be prevented by using evaporated milk or the prepared and fully fortified infant formulas, which do not even have to be heated before feeding. It is likely, also, that the internists in Baltimore would have strongly protested the exposure of some of their adult male patients to the risk of chronic iron intoxication. It might have been pointed out, I fervently hope, that the contribution of these fortified cereals to the infant's iron supply would be meager if not nil, and that providing fully fortified prepared formulas to all infants not only would solve this problem but help conserve the mother's precious time. The proper course is thus clear: definition of the problem and its causes, elimination of the latter when possible, and a working out of solutions that are compatible with resources available and with firmly entrenched custom.

In the backward areas of the world the long-term goal should obviously be the elimination of poverty, ignorance, and filth—no small task. Until such time, however, much can be done to mitigate the problem of malnutrition. First and foremost is a careful delineation of the problems existing in different areas and in different groups within the same area. School lunch programs will do nothing to prevent infant malnutrition in an urban slum. The most important measures against this growing problem have nothing to do with food: family plan-

ning when indicated, and facilitation of breast feeding when humanly possible. Next on the list of alternatives is an adequate substitute for human breast milk. It would have to be not only of comparable nutritional value, but also inexpensive, safe out of refrigeration, simple to prepare, and of an appearance and odor which the mothers would consider desirable. Once formulated, its biological value would have to be confirmed in experimental animals and in infants of the age for which it is intended. At this point, mass feeding trials would add little and only delay its introduction: available resources should be used to make sure that it gets to those who are clearly identified as being in need. The important questions will then be who will pay for it and how it will be distributed.

If the problem is one of undernutrition and malnutrition in pre-school children, the first task is to define its magnitude. If it is only sporadic it can be predicted that a feeding trial involving all children of this age group will probably be inconclusive and that mass programs are not indicated. The need is for early case-finding and for help in solving family problems. If malnutrition in this age group is widespread, broad programs are indicated. To plan these it is necessary to know what foods are being regularly consumed by this age group, since these will often be specific items subject to relatively simple fortification. If such cannot be identified it may be possible to find items which are not consumed regularly but which enjoy prestige and, once fortified, could be promoted for regular consumption. Or it may be that more nutritious approximations of traditional foods will have to be developed. Once the nutritional value of fortified or new foods is confirmed and their acceptability and tolerance is documented, the question of mass feeding trials comes up.

Cogent arguments for such trials can be and are made. The questions asked most often are whether these foods will actually reach the target group and whether they will indeed improve their nutritional state. The first of these is pertinent but certainly does not require a lengthy field trial which might not even duplicate actual conditions. Whether the food in question is to be given away or sold, it will take relatively little time to determine whether it does reach the target group preferentially. If it does, and if it was properly conceived, the second question, which does require prolonged observation, is irrelevant. For such a food to have been properly conceived it is important that a significantly prevalent deficiency state must have

been documented. To have expected field proof of the efficacy of vitamin D fortification of milk before introducing this measure in a milk-drinking childhood population with endemic rickets would have been a travesty. The same would be true of delays in adding carefully chosen amounts of other micro-nutrients to a generally consumed food in areas of documented endemic deficiency.

Where the nutrient in question is an essential amino acid, and the deficiency state is protein malnutrition, the situation, though analogous in many respects, is not as clear. Given a population with endemic pellagra regularly consuming a cereal which could easily and economically be enriched with tryptophan, without altering its acceptability, we probably should not and would not hesitate. If we assume another population in which various degrees of protein malnutrition are endemic among pre-school children, and we know that wheat flour is their regular major source of energy and protein, and we know that the utilization of wheat protein can be increased approximately 50% by appropriate lysine enrichment, and this last can be done economically without altering the acceptability of wheat flour, there is little justification for delaying such action. This should not be reason, however, for abandoning the study of other alternatives, such as fortification with fish or soy proteins. If this were possible without altering the characteristics of the wheat flour, and at a bearable cost, it would be a superior alternative.

If the food in question has been significantly altered by enrichment, or if it is an entirely new food, the situation is quite different. In the first case, consideration must be given to the possibility that the consumption might decrease, with adverse effects. Field trials are probably indicated to answer this question. The opposite alternative, that of increased consumption and possible displacement of other nutritionally important foods, or the creation of a relative deficiency of another nutrient, should be anticipated by making the enriched food nutritionally complete. The same holds true for totally new foods. If these are designed only to correct deficiencies in a theoretically average diet and they are successfully introduced, they are certain to produce a nutritional imbalance. Foods such as Incaparina and CSM obviate this hazard by being nutritionally complete, and only require assurance of reaching the target population, not field trials of their nutritional adequacy, already well documented. In dealing with populations with a proven high incidence of childhood protein

deficiency we have not hesitated to introduce milk, since we never doubted its nutritional value. Our mistake has been in assuming the same high tolerance rate enjoyed by our children.

Returning to the field trials mentioned earlier, certain final observations are in order. Total effective caloric intake over long periods, the principal determinant of growth rates, is governed by many environmental factors, and is seldom limited by the availability of food. Except in near-famine conditions, we cannot ex-

pect to increase the growth rates of children in hostile environments by improving the quality of their staple foods or by introducing superior new foods. These measures, however, can reduce the incidence of malnutrition and the elevated mortalities related to it.

Field trials can and should be used to attempt to answer other important questions such as the possible effects of improved nutrition in reducing the frequency or severity of infections and in improving the mental and behavioral characteristics of underprivileged children.