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FINAL REPORT

NUTRITIONAL IMPACT AS A FUNCTION OF VARIATION IN TYPE AND QUANTITY OF SUPPLEMENT

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1. STUDY ORGANIZATION

This document describes the design, implementation and evaluation of an experimental study carried out to test the impact of various types of food supplements on the dietary intakes and on the nutritional status of young children in Costa Rica. The study was funded in part by a Small Research Grant provided by the U.S. Agency for International Development (DAN-1046-G-SS-1077-00). This funding supported the design of the study, guidance in its conduct and analysis of results by the Chilean consulting firm, INUAL. The grant also contributed in part to the collection of field data by CITA, Costa Rica's Food Technology Research Institute. Supplementing this support, the Costa Rican organizations, CITA and Asignaciones Familiares also made major contributions as noted below.

The role of the three groups can be briefly described as follows:

1. INUAL (Nutrition and Food Engineering Consulting Company, Chile) was responsible for the administration of the grant, the specification of the research design, the supervision of the implementation of the study and the analysis of the results. The design and the analysis of the results were activities carried out in Chile by INUAL, while the supervision of the implementation of the study was done by means of two trips to Costa Rica.

2. CITA is a semiautonomous institute affiliated with the University of Costa Rica and with the Ministries of Health and Agriculture of Costa Rica. CITA provided technical staff and field personnel. CITA was also in charge of the day-to-day conduct of the study and had the responsibility of delivering clean data files to INUAL.

3. Asignaciones Familiares, an office of the President, was in charge of the national health and nutritional program of Costa Rica. It supplied the Family Food Basket and Nutrisoy, two of the experimental treatments included in the study.

In addition, INUAL wishes to acknowledge the contributon of Reynaldo Martorell, Associate Professor, Food Research Institute, Stanford University, who participated with INUAL in a review and analysis of the study's findings and a reporting of that analysis.

2. SUMMARY AND CONCLUSIONS

A great many nutrition programs for pre-school children require the mother to pick-up a food at periodic intervals for preparation and feeding to the young child. A major problem limiting the effectiveness of these programs is that a significant portion of this food is given to family members other than the intended beneficiaries with attendant diminished benefit for target children. A possible solution to this problem may lie in the type and amount of food used in the distribution program. For example foods which appear particularly suitable for young children or foods that for some other reason are not perceived as attractive for general family consumption might be fed in greater proportions to young children.

Very little information exists, however, as to whether in fact nutritional impact of a take-home program does actually vary as a function of either type or amount of supplement provided. The objective of this study was to help fill this knowledge gap. The study sought to answer the question: is there a relationship between the type and amount of supplement provided and changes in nutritional status in the target beneficiaries? To do so foods were delivered to test homes for a period of four months. Six experimental groups were included: the Family Food Basket, providing dietary staples (e.g. rice, beans and including one third oil) with the aim of

improving the dietary intake of the entire family (2000 kcal per day per family); Rice Cereal, a weaning food (precooked and roller dried) given at two levels (150 and 300 kcal/day); Nutrisoy, a corn-soy mixture, very similar in composition to the Corn Soy Blend distributed by the U.S. Food for Peace program, (300 kcal/day); and a commercial Cookie given at two levels (150 and 300 kcal/day).

The weaning foods were consumed in bottles or as gruels (Rice Cereal and Nutrisoy) or directly (Cookie). The foods were all packaged in similar fashion. The supplements were delivered once per month to all participating families. In each case the recipients received a very simple onetime instruction on the benefits and use of the food. Costs of the weaning foods were in the same general order of magnitude with the exception of the cookie, a commercial product, which was considerably more expensive. The Rice Cereal was a new product not known to the test population, although they were familiar with other rice based products. Its selection was based on a previous study of weaning practices and food preferences. From this study properties were identified which lead to the conclusion that the rice cereal would likely be perceived by mothers as particularly appropriate for weaning age children. The cookie was also selected as a food that might, due to its acceptability, be effective as a weaning food.

The children were less than two years of age. Approximately 130 children were included in each of the six groups with the exception of the Family Food Basket which had only 50 cases. Dietary intakes (24 hour recall) were measured before the foods were distributed and during the food distribution. Estimates of food supplement consumption were obtained through single 24-hour recall dietary surveys. Anthropometric measures were collected at the beginning and towards the end of the study.

The most important findings of the study can be summarized as follows commencing with effect on intake and proceeding to effect on nutritional status itself. First, and the strongest finding, consumption of supplement did vary by type of supplement.

Specifically, the key findings were as follows:

Group	Mean (kcal/day) consumed from the supplements (See Table 34) 1/
FFB	106
Rice 150++	118
Rice 300+++	121
Cookie 150	57
Cookie 300	101
Nutrisoy	58
All Groups	91 ± 113

1/ All values differ significantly from zero ($p<.001$)
++ Value for Rice 150 differs significantly ($p<.05$) from values for Cookie 150 and Nutrisoy
+++ Value for Rice 300 differs significantly ($p<.05$) from those of Cookie 150 and Nutrisoy

As the table indicates, differences between groups in amount of calories consumed were substantial. For example, Rice Cereal at 150 calories is consumed at double the level of calories of Nutrisoy, a supplement containing 300 calories ($p < .05$). Calories conumed from Rice Cereal 150 (as well as Rice 300) were also roughly double the calories consumed from Cookie 150. Both the Rice Cereals and the Cookie at the 300 level also achieve consumption equal to that of the 2,000 calorie Family Food basket. 2/ These findings are also reflected in the percent of children reporting consumption of the supplements and in the percent consumption of energy from the supplement in relation to total amount of supplement distributed.

2/ Intended for all members of the family.

Group	Percent of children reporting consumption (See Table 34)	Percent consumption of energy (See Table 36)
FFB	75	35+
Rice 150	74	79
Rice 300	77	40
Cookie 150	43	38
Cookie 300	58	34
Nutrisoy	31	19

+ Percentage consumption of 300 calories which it is assumed would be child's theoretical share of 2000 calorie Family Food Basket.

With respect to intake of supplement as a function of amount provided, rather than type, the results do not permit conclusions to be drawn. The two cases where different levels of the same supplement were tried did not yield similar results. Thus, in the case of the Cookie, calories of the supplement consumed are roughly double at the 300 level in comparison to the 150 level (101 calories vs. 57 calories). But in the case of Rice Cereal the 150 level and 300 level resulted in approximately the same amount of calories of supplement being consumed (about 120).

One possible explanation for this result is that on the one hand the mother perceived about 100 calories as the upper limit of what she felt appropriate to feed as a supplement or which she found convenient to feed. (More than one feeding may have been required.) On the other, the Rice Cereal appeared to be less popular with other family members as suggested by slower disapearance of the total stock distributed to the mother. If this were the case, it might help to explain why the more "efficient" Rice Cereal would have reached the 100 calorie saturation point at the 150 calorie ration level while the Cookie only did so at the 300 calorie level. The Rice Cereal may also have been perceived not only as being less attractive to other family members but also as more appropriate for the weaning age child .

The study also sought to compare changes in total intake (i.e. home diet plus supplement) between the different groups. The basic findings were as follows:

Group	Changes in total energy intake (See Table 34)
FFB	104
Rice 150	190+++
Rice 300	153++
Cookie 150	99+
Cookie 300	62
Nutrisoy	66
All groups	123 ± 504+++

+p < .05; ++p < .01; +++p < .001

Statistically significant changes in total intake were found for only three groups, Rice 150, Rice 300 and Cookie 150. Dietary intakes increased by 190 and 153 kcal respectively in the Rice 150 and Rice 300 groups while increases in the Cookie 150 were lower, 99 calories. The pattern that emerges is that the Rice Cereal is the supplement both most likely to be consumed by children and most likely to be associated with significant increases in total dietary intakes. However, providing 300 kcal of the Rice Cereal has the same effect as providing 150 kcal of the Rice Cereal.

Proceeding to effect on nutritional status, the most important findings were for changes in the segments of the test groups that were malnourished. Changes in the segment of each group that was nutritionally worst off at the beginning of the study were as follows:

Group	Mean weight for age changes in sample with weight for age less than 80%	% changes in the prevalence of children with weight/age less than 80%	Mean changes in weight for height among children of less than 90%	% changes in the prevalence of malnourishe children with weight/height less than 90%
FFB	6.1+++	35	14.5+++	54
Rice 150	5.2+++	24	5.3+++	30
Rice 300	3.6++	32	5.2++	46
Cookie 150	2.1	0	3.0	0
Cookie 300	3.7++	4	6.6+++	0
Nutrisoy	3.1++	7	5.5++	32
All groups	4.1 ± 5.3+++		6.5±5.5+++	

3/ Data in this table taken from Table 35

++p < .01; +++p < .001

The results indicate some differences by type of supplement. In particular Rice 150 stands out as much better than Cookie 150 and equal to, and by some measures better than, the larger supplements (Cookie 300 and Nutrisoy). Also although Rice 300 does not show improvement relative to Rice 150, the Rice Cereals appear strong by many of the measures in relation to the Cookie groups. The table also provides an interesting comparison with the Family Food Basket. Thus the targeted supplements, in particular Rice 150, do relatively well in comparison to the 2000 calorie Family Food Basket. The latter provides half of its calories as oil.

The persuasiveness of the findings is limited by a number of factors. First, there was no control group to estimate the level of change that would have occurred naturally without the interventions. Some of the changes in dietary intakes, for example, may be due to the fact that children became older during the course of the study. Some of the changes in growth may have also been a function of age. Thus, not all changes that occurred can be entirely attributed to the interventions. However, comparison between groups are valid because all groups were followed simultaneously.

A second problem is that the groups were not entirely homogeneous with respect to factors which condition dietary and growth response to supplementation. Thus, the group receiving the Family Food Basket had the poorest measures of growth and the worst diets at the beginning of the study. The group receiving Nutrisoy, on the other hand, showed the best dietary and anthropometric characteristics at the beginning of the study. One strategy for dealing with problems of noncomparability is to stratify by the variable in question. Thus, analyses were carried out which examined dietary changes by various categories of age, socioeconomic status and initial diet. These analyses did not suggest a different interpretation than that provided by analyses which were not stratified. So that lack of homogeneity did not appear to materially influence the associations observed between type of supplement and total intake. Similar analyses were done for anthropometric changes. In this case also initial diet and nutritional status did not appear to materially influence the pattern of difference between the groups receiving different supplements.

Finally, while in some cases groups that with the higher consumption of supplement had the higher growth, an association between dietary measures and growth could not be confirmed in more detailed analysis at the individual level. This may have been due to the fact that the dietary measures

available in this study are single 24-hour recall measures. Measuring intake once rather than taking an average of several measures can result in a very large variation.

In conclusion, in answer to the question whether there is a relationship between type and amount of supplement and effect on nutritional status in a take-home feeding program, the study indicates the following for the Costa Rica case. First, the strongest finding was that a clear relationship existed between type of supplement and intake of supplement. Second, the study does not permit conclusions to be drawn regarding the effect on intake of amount of supplement as the findings for the two supplements studied in this manner (Cookie and Rice Cereal) are contradictory. Third, statistically significant results for total intake were found for some of the groups, Rice 150, Rice 300, and Cookie 150, and these findings generally supported the pattern found for differences in intake of supplement. Finally, weight for age changes suggest that the nutritional status varied as a function of the type of supplement provided, though it was not possible to show a significant association between measures of intake and changes in nutritional status.

In overall terms the fairly consistent high performance of Rice 150 suggests that an efficient supplement has the potential to make a substantial difference in a take-home program. Further, it is significant that selection of this supplement was based on prior identification of properties likely to result in its perception as particularly appropriate for young children. It is also interesting to note that despite the potential problem of intra-family dilution, a relatively small supplement (150 calories) had similar consumption to that of a family ration that provided the equivalent of about 300-400 calories per family member.

3. BACKGROUND

3.1 Importance of the study

Costa Rica is a country commited to improving the nutritional status of children by means which include the distribution of foods to low income families. As in other areas, the major target population of the Costa Rican food distribution programs has been children in the first few years of life as these are the ones most likely to be malnourished. In order to achieve the greatest benefit at the least cost, the government of Costa Rica was interested in information that would allow them to select those foods that are most efficient in increasing nutrient intakes and in improving nutritional status in young children and agreed to use of one of its feeding programs as a setting for this study.

The literature offers limited guidance in regards to the selection of the appropriate food supplements to use in Costa Rica. Beaton and Ghassemi (1) found that many evaluations of food supplementation programs have yielded inconclusive, lackluster results. Many reasons may account for these results including reductions in the consumption of other foods in the diet, poor acceptability of the supplements by the target groups, consumption of the supplement by family members other than the target individuals, the distribution of foods in amounts too small to have a noticeable effect and finally, the distributions of foods that do not provide enough of the nutrients that are limiting in the diet. On the other hand, recent experiences in Latin America offer a more hopeful outlook about the role of food supplements than the review by Beaton and Ghassemi (1) would suggest.

Researchers in Guatemala have found that the distribution of a high protein calorie gruel resulted in significant dietary and anthropometric improvements(3,4). Mora et al.(5) in Colombia also found significant improvements in nutritional status resulting from a food supplementation program to poor families in an urban setting.

INUAL (6,7) also has found that food supplements produced significant improvements in the nutritional status of children. After a promising pilot evaluation in 300 malnourished children, a program of national coverage was implemented in Chile to reduce the prevalence of second and third degree malnutrition. These and other food supplementation programs in Chile have contributed to the significant decline in malnutrition and infant mortality observed in the last 15 years (15).

Though there is reason to believe that if foods are provided to malnourished children, dietary intakes and measures of growth will improve, project managers still need to test out the alternative products in the local setting. Whether a given food is effective or not depends not only on its nutritional properties and the level of malnutrition prevailing in the population, but also on socio-economic and cultural factors. Important aspects that are specific to the local setting include for example, the significance of the food in the culture, its perceived fitness or appropriateness for children, its resale value, and the way in which the food is promoted and distributed (e.g. take home, once a month, etc) to target families. Other critical issues are the local reactions to the taste, color, texture and packaging of the food supplements.

In this study, an evaluation of the effects of a food supplementation experiment on nutrient intakes and physical growth is described. This study was carried out in Costa Rica by CITA and INUAL. *

3.2 Study objectives

An experiment was planned to measure the nutritional effects of various food products pilot studies had suggested might prove effective in improving nutritional status and which were believed to be likely to be accepted by Costa Rican children or their mothers.

In addition to including different types of foods, CITA and INUAL felt it was necessary to test the effect of varying the amount of supplement to be provided. Three elements were selected as key factors in assessing the relative success of the food interventions: acceptability of the food by children, changes in dietary intakes and changes in nutritional status as measured by anthropometry. Finally, it was considered important to collect information about socioeconomic status and morbidity in order to control for these factors in data analysis.

The goal of the institutions participating in the study was to provide information that would prove useful in the design of national projects in Costa Rica and would contribute to project formulation in other countries.

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* See section 1 for a description of the study participants.

3.3 Pre-test

The study described here, was informed by extensive pilot studies carried out in 1980(8). Detailed socio-anthropological studies were carried out to assess weaning practices and general food habits and beliefs in order to identify preferences for specific kinds of foods for young children. Based on these investigations, a roller-dried instant rice cereal was selected as the best possible food to be used.

A pilot study was then designed to test the nutritional effects of the rice cereal. Some 200 low socio-economic children, between the ages of 6 and 24 months, were included in the pre-test. Four experimental groups were included in the study: a) a control, b) a group receiving rice cereal with banana flavor (384 kcal/day), c) a group receiving rice cereal but without flavor (384 kcal/day), and finally, d) a group receiving rice and beans for the entire family (about 1500 kcal/day per family). The study lasted three and a half months and consisted of two phases, the first being the baseline during which no foods were distributed (1.5 months in duration) and the second the experimental phase (2 months in duration). Some results from these studies have been published(8) and these suggest that the two cereal products had high acceptability. However, there were indications that the cereal without flavor had a greater impact on dietary intakes, particularly in energy, than the cereal with banana flavor. Our unpublished data suggest that there were improvements in anthropometry and in dietary intakes in all experimental groups but that these changes were not statistically significant because of small sample sizes. Other study findings were that the banana flavor made the rice

cereal popular with older family members such that less of the cereal was available for young children. This would explain the larger dietary impact of the rice cereal without flavor. Also, it was found that four times as many calories from rice and beans were required to achieve the same effect produced by the unflavored rice cereal, suggesting therefore, that a food targeted to the child (i.e. rice cereal) is more effective than one aimed at the entire family (i.e. rice and beans).

3.4 Economic Background

The economic situation in Costa Rica turned for the worst between the time the pre-test just described above was carried out (1980) and the implementation of the study proper in September, 1982. These changes had grave consequences for the study as will be seen in later sections.

The labor force grew by 27,000 persons per year during 1979-80 while the number of workers employed increased by 26,000. Between 1980 and 1982, the situation worsened in that the labor force increased at a rate of 4% while the number of employed grew by only 2% per year. A similar pattern is revealed in Table 1 by the unemployment rate. Between 1979 and 1982, the unemployment rate nearly doubled, rising from 35 to 62%.

While the nominal salary of the employed increased by 140% between 1977 and 1982 (9), the rise in retail prices was greater, 272%. This meant in effect, that a marked decline had taken place during this time in the purchasing power of the Costa Rican worker. Relative to 1978, prices increased by 100% for foods of vegetable

orgin and by 94% for foods of animal origin (Table 1). The food items showing the greatest increases in prices were meat, fresh milk, eggs, rice, sugar, beer, bread, fat, beverages, beans and corn.

Another factor contributing to the economic crisis of the country was the drop in the value of the goods exported by Costa Rica in 1980; exports were down in 1982 by 132 million or 14% relative to 1981. This decline occurred simultaneously with a massive devaluation of the national currency.

The economic crisis was acute in 1982 when the study was about to begin. This may have had at least two important consequences for the study. First, the diets and nutritional status of the Costa Rican population may have worsened during the course of the study, an aspect that needs to be taken into consideration in the interpretation of the results. Second, as a response to the apparent nutritional deterioration in the country, the government began a massive food intervention in most areas of the country. Private volunteer organizations also became increasingly involved in food distribution programs but on a smaller scale than did the government. These activities, which the study participants were powerless to control, reached the study areas and affected the execution of the study and complicated the analysis and interpretation of the findings.

Table 1: Selected macroeconomic indicators for Costa Rica: 1979-1982

	1	2	3	4
1979	35.4	-	-	-
1980	-	12	18	905.6
1981	40.1	69	66	930.1
1982	60.8	100	94	798.1

1 Unemployment rate in the labor force (a)
2 % variation (base 1978 = 100) in the price index for foods of vegetable origin (b)
3 Idem for food product of animal origin (b)
4 FOD exports in millions of dollars (c)

(a) Source: Household National Survey. Office of National Planning and Economic Policy: Population Labor Force and Employment in C. Rica. Population Department. San Jose, C. Rica. (10)
(b) Source: Economic Bull #1667. Central Bank of C. Rica. Dec. 1982 (11)
(c) Source: General Office of Statistics and Surveys. Central Bank of C. Rica. (12)

4. RESEARCH AND DESIGN AND SAMPLING METHODS

The research design as well as the sampling methods originally defined underwent major transformations because of the influence of the external factors noted above and also because certain local conditions were found to be different than expected.

4.1 Research design

The design originally proposed included six groups as shown in Table 2: a control group, two groups receiving rice cereal, two groups receiving cookie and one group receiving nutrisoy#. The collection of longitudinal baseline data collection was not contemplated but cross-sectional measurements at the beginning of the study were included.

Shortly before the study began, it became clear that the newly elected government of Costa Rica was about to initiate a food intervention program in the country, including the study area. Costa Rican government officials agreed to stay away from the intervention areas but the inclusion of a control group disturbed them. Specifically, Costa Rican government official felt it was unethical to have families who would not benefit from a program available at the national level. Hence, in accordance with their wishes, the control group became the "Family

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The names given to the groups in Table 2 will be used in subsequent Tables and Figures.

Food Basket" group receiving the food items chosen for the national government program. The agency in control of the government intervention was "Asignaciones Familiares" which agreed, as noted already, not to extend the "Family Food Basket" program into the other experimental areas.

Soon after another complication emerged. Other government and nutritional agencies began their own programs of food distribution (called in Table 2 and in subsequent Tables "government food intervention"). Church groups also participated with their own programs but on a smaller scale than did the government. Since these programs were not coordinated by Asignaciones Familiares, the agency responsible for the Family Food Basket, these activities were outside the control of CITA and INUAL. As shown in Table 2, the effect was that at least some members of all study groups participated in the "government intervention" in addition to participating in the interventions specifically promoted in the study. The basic food distributed in the unexpected government food intervention was powdered milk though other foods, principally cereal products for younger children, were also given. The program was not highly structured nor was the distributor of foods very systematic. Unfortunately, specific information about amounts of foods received under the program was not available. The only available information was whether or not a family participated in the "government food intervention."

4.2 Rationale for the food interventions

The Rice Cereal was included because of the promising results found in the pilot study which confirmed earlier findings from study of food habits and preferences.

Table 2: The evolution of the research design

Original Plan		Actual Development
Control	Family Food Basket	Government Food Intervention
Rice 150[1]	Rice 150	
Rice 300[2]	Rice 300	
Cookie 150[3]	Cookie 150	
Cookie 300[4]	Cookie 300	
Nutrisoy[5]	Nutrisoy	

1. Receiving 150 kcal/day from the rice cereal
2. Receiving 300 kcal/day from the rice cereal
3. Receiving 150 kcal/day from the cookies
4. Receiving 300 kcal/day from the cookies
5. Receiving 300 kcal/day from Nutrisoy

The Cookie was selected as an alternative vehicle to supplement energy intakes because of its high potential to be consumed by young children. Fieldwork had suggested high acceptability; this same work had given information about the ideal characteristics (i.e. color, form, taste) of the cookie (see appendix 1). Four types of cookies were then selected and pre-tested on a sample of 72 families having children under two years of age (see appendix 2). The results indicated that a type of popular cookie by the name of "Maria Dorada"+ offered the best possibilities of success.

Nutrisoy++ was the only food similar to items given under PL 480 Title II programs. Previous work had suggested that nutrisoy had low acceptability in adults. This fact suggested either that mothers would consider it inappropriate for adults as well as children or, the reverse, that it would be given preferentially to children since adults did not like it.

All these foods, the Rice Cereal, the Cookie and Nutrisoy, were aimed at the child. All except the Cookie, were meant to be prepared as gruels and to be fed by bottle or by cup and spoon. The Family Food Basket, on the other hand, had an entirely different philosophy as the name implies. The family, rather than just the child, is the target; also, the Family Food Basket contains items (i.e. the dietary staples) that have a high resale value. These two factors, the appropriateness of the foods for adults and their high economic value, could in theory, limit the

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+ The cookies used in the study were produced by the CUETARA Company of Costa Rica, the producer of Maria Dorada in Costa Rica.

++ Nutrisoy was produced by the CARE extrusion plant.

impact of the Family Food Basket on the diets of children.

Two levels of supplementation, based on pre-test results, were included in the study to test for dose response relationships. The two levels were 150 and 300 kcal/day and the foods tested in this manner were the rice cereal and the cookie.

4.3 Amounts of supplements provided

Food supplies were delivered once a month to all participating families. The amounts provided are given in Table 3 which in addition contains the daily energy and protein which these supplements provide. Nutrisoy stands out as being higher in protein. The group "Rice 300" is intermediate in terms of its protein content with 16 g/day and the rest of the supplements provide less than 10 g/day.

Analysis of the dietary data have shown that, relative to the FAO/WHO estimated requirements, the limiting nutrient in the diet of the study children was energy and not protein. We estimated that the average protein intake was 40% higher than the allowance for protein while mean energy intakes were 30% less than the requirement. The aspect of major significance therefore, appears to be the energy content of the supplements. Nutrisoy, Cookie 300 and Rice 300 are higher in energy value (300 kcal/day) and Cookie 150 and Rice 150 are lower (150 kcal/day).

A detailed chemical composition, per 100 grams of dried base, is given in Table 4. Clearly, the supplements contained significant amounts of many nutrients.

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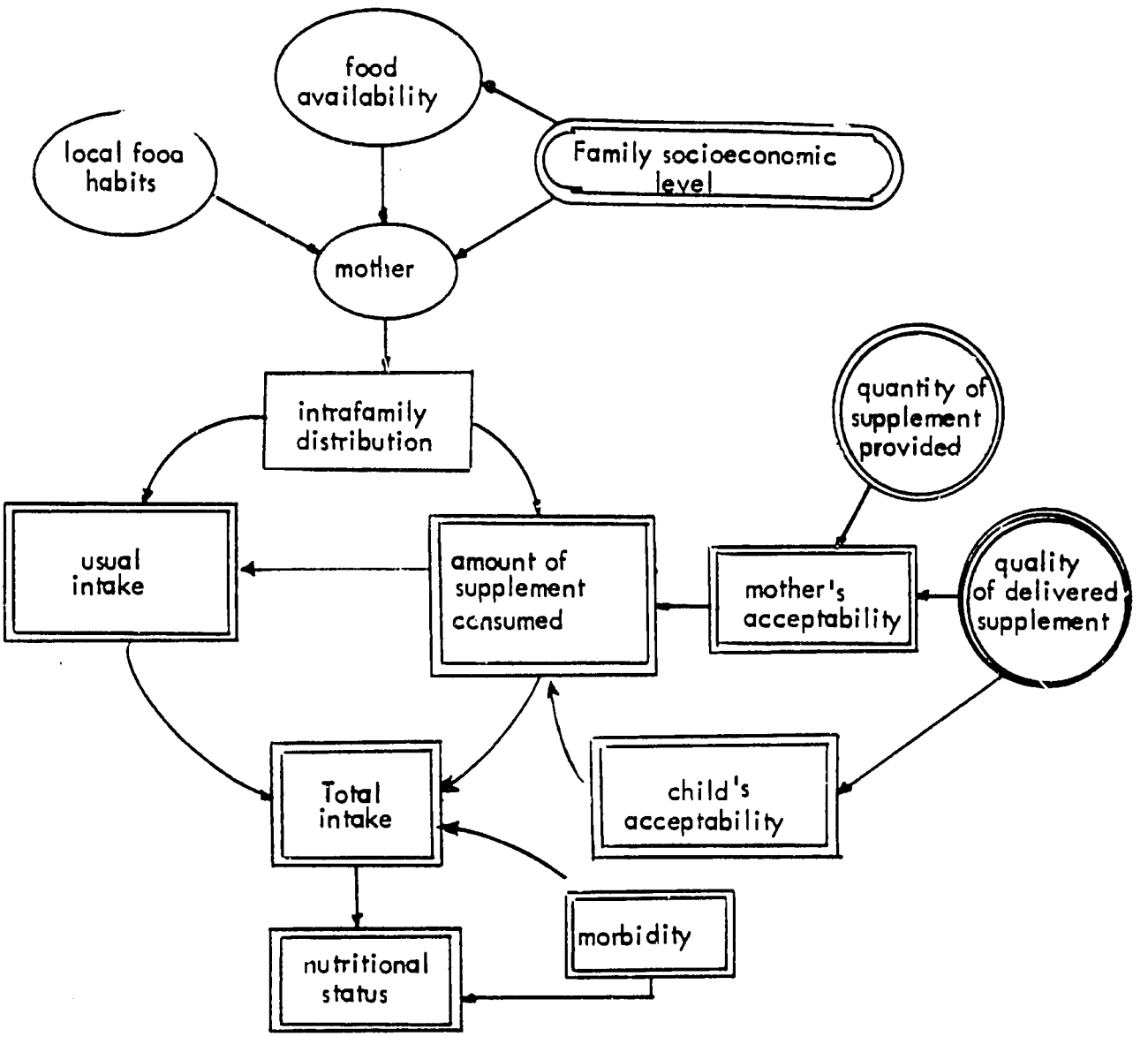

Fig. 1 : A model of the nutritional impact of food interventions. Double line indicates variables which were measured in this study.

Table 3: Amounts of supplement provided per month

Group	Monthly Ration (kg)	Energy (kcal/day)	Protein (g/day)
1. Family Food Basket#			
- Soy oil	3.7	1.090	-
- Beans	1.0	112	20.6
- Sugar	2.0	256	-
- Rice	2.0	246	8.7
- Frescohorchata	2.5	333	16.7
		2.034	46.0
2. Rice 150	1.0	150	7.8
3. Rice 300	2.0	300	15.6
4. Cookie 150	1.0	150	4.5
5. Cookie 300	2.0	300	9.0
6. Nutrisoy	2.5	300	23.7

The amount given is independent of family size.

Table 4: Chemical composition of the experimental foods (per 100 gms of dried base)

	Family Food Basket	Rice Cereal	Nutrisoy	Cookie
Protein (g)	11.7	7.75	23.7	4.5
Fat (g)	33.2	11.13	9.7	21.5
Carbohydrate (g)	37.7	77.05	63.6	60
Fiber (g)	5.2	.52	3.0	NA
Ash (g)	3.9	2.23	NA	NA
Calcium (mg)	110	659	2.7	32
Phosphorus (mg)	519	549	NA	76
Iron (mg)	11	70	1.7	1.1
Vitamin A (IU)	10	NA	1650	NA
Thiamine (mg)	1.3	1.64	.27	NA
Riboflavin (mg)	.3	1.97	.37	NA
Niacin (mg)	5.4	14.56	4.9	6
Ascorbic acid (mg)	3	NA	40	NA
Energy (kcal)	545	446	380	419

NA, not available

4.4 Sampling design

The original intent was to use the information routinely collected by selected health centers to identify the study sample. However, an inspection of the information found it to be incomplete and sometimes inaccurate and this idea was discarded.

Instead a more expensive and time consuming method was chosen, the basis of which was a house-to-house screening of the poorer areas of San José. During a three month period, 2000 families were interviewed and if a child under two years of age was found, data were collected in the following areas: antropometry, maternal education, occupation of the head of household, the child's age and the exact address of the house.+ From this information, 32 neighborhoods or sectors from 11 communities were selected for study (Table 5). The next step was to assign the 32 neighborhoods to the six experimental groups. This was not done at random. Instead, care was taken to distribute a similar number of children with weight for age less than 80% WA ("malnourished"). The rationale for this procedure is that previous studies by INUAL and others suggested that food supplements cause the greatest impact on those children with the poorest nutritional status. The results of this exercise are shown in Table 6. The number of "malnourished" children ranged from 16 (Cookie 150) to 25 (Nutrisoy). Unfortunately, in the attempt to "enrich the sample with malnourished children" homogeneity for some factors was affected As shown in Table 6, the

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+ This process took longer than expected because there was a conscious effort to include as many children as possible with weight for age values less than 80% and who were not receiving any form of food aid. The population finally selected was not therefore representative of poor Costa Rican communities. Rather, it was a sample more malnourished than the general population.

Table 5: The thirty two neighborhoods selected for study

Village	Neighborhood	Socioeconomic classification of the neighborhood+
Desamparados	Calle Falls	5
	Rio Azul	5
	Chapulines	5
	La Paz	5
	San Rafael Arriba	5
Hatillo	Calderon Fournier	5
	Nietos de Carazo	5
	Promesas de Carazo	5
Alajuelita	Concepcion Arriba	5
	Concepcio Abajo	5
Cristo Rey	La Tabla	5
Desamparados	Higuitos	4
	Torremolinos	4
	Calle Victoria	4
Hatillo	Sagrada Familia	4
	Barrio Cuba	4
	Aguantafilo	4
Alajuelita	San Josecito	4
	San Felipe	4
	Centro Alagjuelita	4
Cristo Rey	San Juan de Dios	4
	Centro Cristo Rey	4
	San Sebastian	4
	Paso Ancho	4
	Barrio Los Angeles	4
	San Rafael Abajo	4
Aserri	Poas	4
	Las Mesas	4
	Centro Aserri	4
	Salitrillo	4
Desamparados	Centro Desamparados	3
Hatillo	Centro Hatillo	3

+ Based on the Marcel Graffar's socio-economic classification (see appendix 3)

Table 6: Weight for age distribution in the original sample

Group	Sample Size	< 80 WA		80-90 WA		> 90 WA	
		n	%	n	%	n	%
FFB	65	21	32.3	23	35.4	21	32.3
Rice 150	153	23	15.0	47	30.7	83	54.2
Rice 300	176	23	13.1	59	33.5	94	53.4
Cookie 150	157	16	10.2	56	35.7	85	54.1
Cookie 300	106	18	17.0	42	39.6	46	43.4
Nutrisoy	207	25	12.1	42	20.3	140	67.6
Total	864	126	14.6	269	31.1	469	54.3

groups were not homogeneous in terms of the number of malnourished children or of the total sample sizes. Therefore, the prevalence of malnourished children shows a wide range among experimental groups

The study was not begun at the time the data for Table 6 were collected but a few months later. Though the original allocation of neighborhoods to experimental groups was maintained, some children moved out of the neighborhood and the sample as a whole became more malnourished. Hence, Table 6 is more important in terms of understanding the history of the study than it is useful for describing the status of the population at the beginning of the study. The better point of reference is the status of the samples at the true beginning of the study (see Tables 7 through 10 in section 6.1).

5. METHODOLOGY

Figure 1 shows a simplified model of the nutritional impact of the food interventions. Double lines indicate variables which were measured in this study. Arrows indicate influences of one type of variable on another.

5.1 Types of variables and methods used

The data forms used for anthropometry, socioeconomic status and morbidity are given in appendix 5.

5.1.1 Socioeconomic status

The Graffar index was used (see appendix 3). The index has five subindices: profession of the head of household,

income, quality of the house, education of head of household and type of neighborhood. Values within each subindex range from 1 (best) to 5 (worst). The total for all subindices were added and the family was assigned to any of five categories: 25 to 21 was coded as 5, 20-16 as 4, 15 to 11 as 3, 10 to 6 as 2, and 5 or less as 1. No families in categories 2 and 1 were found.

5.1.2 Morbidity

Mothers were asked to recall the incidence and duration of symptoms which their child may have had in the last month. Mothers were encouraged to record morbidity events in a calendar. Though data were collected for fever, anorexia, cough, diarrhea, bronchitis and "other infectious illnesses", the variables available for study at INUAL are two: an index of diarrhea and an index of respiratory infections. These variables were obtained by factor analysis as explained in appendix 6.

5.1.3 Anthropometry

Length+ and weight were measured following standard techniques. Portable spring scales were used to measure weight to within 100 grams. Length boards were used for measuring length. NCHS data were then used to generate the following age-sex specific indicators: % of median weight (weight

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+ The measurement is technically length (measured in supine position) and not height (measured standing). However, "height" is used throughout the text to conform with popular usage.

for age or WA), % of median height (height for age or HA) and % of median weight for height (weight for height or WH).

5.1.4 Dietary methodology

The 24-hour recall was used. The mother was interviewed and asked about her child's intake on the previous day. Information about each food was recorded in household units (cups, spoons) and the amounts were later estimated in grams. Finally, using food composition tables, these amounts were converted to nutrients. From this information, the following variables were generated:

- the total intake of energy and protein
- the energy and protein contributed by the supplements

The total intake variable is the sum of the contribution of all foods which were consumed while the supplement contribution is a function only of supplement consumption. It is important to note that supplement consumption and usual food consumption were collected simultaneously. The two measures are not therefore independent.

5.1.5 Participation in other programs

The dietary form also included a series of questions about the participation of the family in what was termed the "government food intervention". These questions recorded whether any "help" was being received and specified what was being given (i.e. powder milk, powder milk with cereal,

etc). Unfortunately, the only variable available to INUAL was qualitative: whether or not the family participated in any of the programs making up the "government food intervention".

5.1.6 Acceptability

There were two measures of acceptability in addition to the actual consumption of the supplements. Mothers were asked whether their children and the family as a whole liked the supplements. Also, when the supplements were delivered once a month, the amounts, if any, left over from the previous month were recorded.

5.2 Food delivery

The food supplies were delivered to each household once a month. The packages had a label with the child's name and a note stating that the food was to be consumed by the child only. The acceptability survey was carried out at the same time the foods were delivered to the households.

5.3 Periodicity of data collection

The periodicity of data collection is given in Figure 2. There were five anthropometry and morbidity surveys over a period of five months. The December measurements were however discarded because of very poor coverage due to the festivities and holidays which generally occur during that month. There were three acceptability surveys and four months of food distribution. Only two measures of dietary intakes were carried out, one at the beginning and one near the end of the study.

Area	August	September	October	November	December
Anthropometry	—	—	—	—	—
Morbidity	—	—	—	—	—
Acceptability	—	—	—	—	
Food distribution	—	—	—	—	
Dietary intakes	—		—		

Figure 2 : Periodicity of data collection (1982)

The periodicity of measurements shown in Figure 2 differs from the scheme originally planned. For example, the study contemplated two months of post-experimental observation to monitor anthropometry and diets. Because the initiation of the study was delayed, this plan had to be dropped.

Not all of the potential information was available to INUAL nor was all available information used in the final analyses. The anthropometric and morbidity surveys for September and October were not analyzed and, though available to INUAL in raw data form, were not used. Their use would have required greater resources than available in terms of time and computer costs. Therefore, for diets, anthropometry and morbidity, the basic comparison in this document is between initial and final values.

5.4 Field work

All the field work was carried out by Costa Ricans under the supervision of professionals from CITA. The nine field workers employed were carefully selected from among those (n=20) who participated in the pre-stduy. The one judged to be the "best" was chosen to be the supervisor. All were university graduates and all showed much enthusiasm and dedication.

The team was divided into four groups of two each. The teams were to have been rotated among all areas but soon it became apparent that it was best to leave them in one place so that they could best become familiar with the terrain. There are no "addresses" in the study neighborhoods (e.g. houses have no numbers and streets have no names), only reference points, and in the peri-urban area, the lack of a grid system of streets made familiarity with the area very desirable.

To facilitate locating the houses, maps of the area were made and the position of each house was noted. Mothers were also asked to contact CITA if there was a change of address. In this manner, some sample size losses were averted.

5.5 Quality control

The field workers received extensive training prior to the study. They practiced anthropometry in health centers, spent three days in the study sites acquiring familiarity in the use of the socioeconomic questionnaire and spent a week learning how to interview mothers about the diets of their children.

The field work was supervised by three persons. A paediatrician was in charge of the anthropometric examination and the morbidity survey; the pediatrician also measured children on some occasions to verify the accuracy of the field workers. A nutritionist-anthropologist checked the 24-hour recall survey data forms and the coding of all the food items. An economist supervised the socioeconomic and the acceptability questionnaires.

The daily flow of information from the field is given in Figure 3.+ Through these procedures many errors were detected. Lastly, Figure 4 shows the flowsheet for the processing of the information.

+ The word "perfoverificar" is a Spanish term meaning punching and verifying of data.

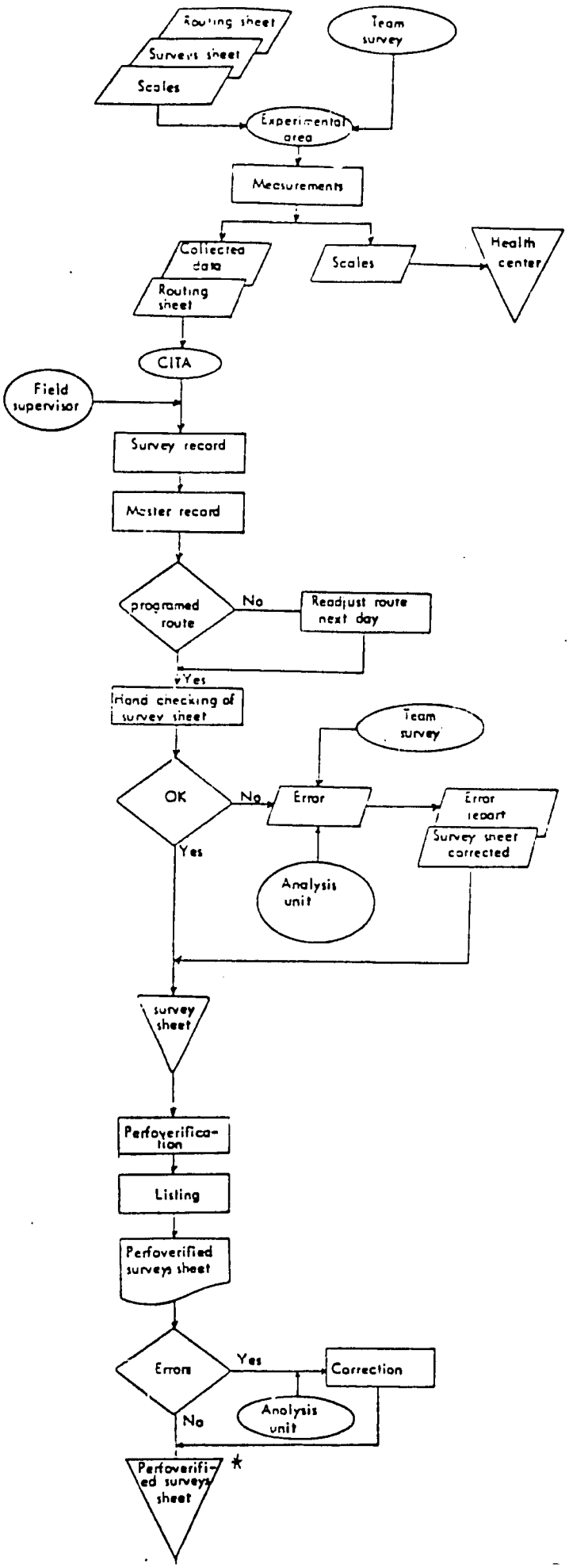
Routing sheet
Surveys sheet
Scales
Team survey
Experimental area
Measurements
Collected data
Routing sheet
Scales
Health center
CITA
Field supervisor
Survey record
Master record
programed route
No
Readjust route next day
Yes
Hand checking of survey sheet
Team survey
OK
No
Error
Error report
Survey sheet corrected
Yes
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Figura Nº 3

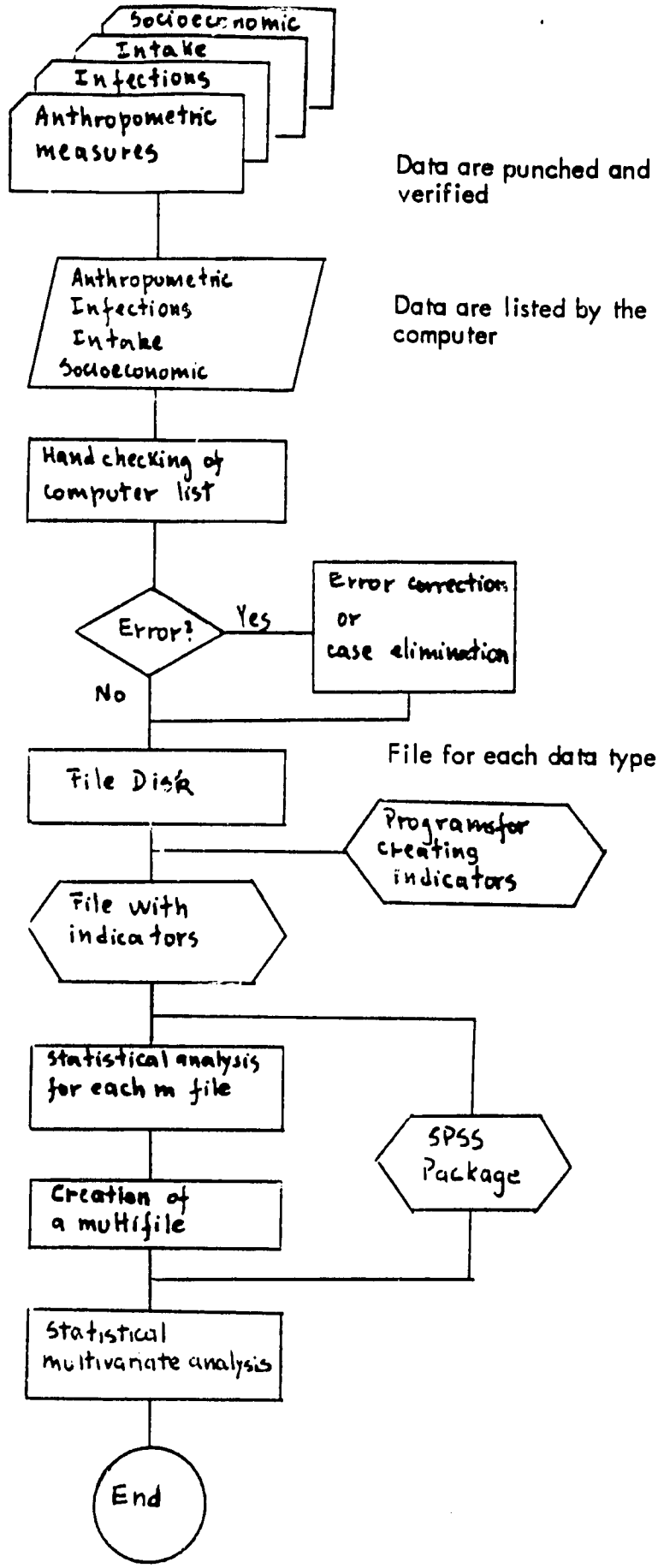

Fig. N°4 : Flowsheet. Information process

6. RESULTS

The organization of the results goes from the simplest to the complex, from simple descriptive tables and figures to multivariate analysis. An effort was made to provide as much information as possible regarding the variables in the analysis. The key dependent variables, or the criteria by which the success of the interventions are assessed, are changes in the energy and protein intakes of the study children and changes in anthropometric characteristics. Food supplement consumption is more often presented as the key independent variable, particularly in the multivariate analysis. The other variables, participation in the government food intervention, socioeconomic status, initial weight for age, age, and morbidity, are generally used as conditioning or potentially confounding factors. Finally, though a great deal of information is presented about protein intakes, energy is emphasized in the presentation. A brief summary follows each section.

6.1 Comparability between groups

The first question asked was the following: were the experimental groups comparable at the beginning of the intervention in terms of variables that may condition the response of the group to the supplements. As key aspects to consider we included sample size, participation in the government food intervention, socioeconomic status, initial nutritional status (WA) and initial dietary intakes.

For the reasons already given, the sample available at the beginning of the study was less than at the time the study children were first identified. This is evident in Table 7 if the first and second columns are compared. Sample size losses varied

between 29% for Rice 300 and Nutrisoy and 20% for Rice 150. The final sample sizes are very different across groups from 50 for the FFB to 147 for Nutrisoy.

The distribution of cases by categories of socioeconomic status is given in Table 8. The poorest category is 5 and includes 23% of the total population. The intermediate group (category 4) is the most numerous with 62% and the better off group (category 3) is the least common with 15%. Rice 300 and FFB are the groups with the highest proportion of households in category 5, 40 and 32% respectively. Nutrisoy, on the other hand is the group with the least prevalence of poor households, 12.2%

The pattern noted in Table 8 is reflected in Table 9 where FFB, one of the poorest, has the highest prevalence of children with WA values less than 80% and Nutrisoy, the highest in socioeconomic status, has one o e lowest prevalence of very low weight children.

Table 7
Sample size losses

Group	Initial number identified+	Cases with anthropometric data at the beginning of the study	% of initial number
FFB	65	50	77
Rice 150	153	123	80
Rice 300	176	125	71
Cookie	157	116	74
Cookie 300	106	79	75
Nutrisoy	207	147	71
Total	864	640	74

+ From Table 6.,

Table 8
Distribution (%) of the sample by socioeconomic status (1)

Group	Sample size	Socioeconomic levels 3	4	5	Total
FFB	50	6.0	62.0	32.0	100.0
Rice 150	123	15.4	71.5	13.0	99.9
Rice 300	125	12.0	48.0	40.0	100.0
Cookie 150	116	18.1	60.3	21.6	100.0
Cookie 300	79	11.4	60.8	27.8	100.0
Nutrisoy	147	18.4	59.4	12.2	100.0
Total	640	14.7	62.3	23.0	100.0

(1) Marcel Graffar's socioeconomic classification

Table 9
Distribution (%) of cases by categories of weight for age at the beginning of the study

Group	Sample size	< 80% WA	80-90% WA	> 90% WA	Total
FFB	50	46.0	30.0	24.0	100
Rice 150	123	26.8	35.8	37.4	100
Rice 300	125	22.4	30.4	47.2	100
Cookie 150	116	13.8	37.1	49. 1	100
Cookie 300	79	27.8	43.0	29.1	99.9
Nutrisoy	147	19.0	34.0	47.0	100.0
Total	640	41.6	35.0	23.4	100.0

Nearly 40% of the children participated in the government food intervention, which aimed to reach the poorest of the poor (Table 10). Rice 150 and Cookie 150 are the groups with the least participants while Cookie 300 and FFB are the groups with the most participants.

There were no important differences among groups in the ages of the children. The comparability in diets is discussed in section 6.2 below.

In summary, there are differences between experimental groups in aspects that might influence acceptability of the supplements and the dietary and anthropometric response to the supplement. Specifically, there are potentially important differences among groups with respect to sample sizes, socioeconomic status, participation in the government food intervention and prevalence of malnutrition. On the other hand, the groups are more similar with respect to sample size losses and age of the children.

Table 10
Percent of children participating in the government food intervention

Group	Sample size	Participants	%
FFB	50	27	54
Rice 150	123	24	20
Rice 300	125	59	47
Cookie 150	116	32	28
Cookie 300	79	48	61
Nutrisoy	147	59	40
Total	640	249	39

6.2 Changes in total energy and protein intakes

The interest in this section is to describe the changes which occurred in energy and protein intake and to explore whether these changes differed across experimental groups or whether they depended upon characteristics such as age and initial nutritional status.

Figure 5 illustrates where each experimental group began and ended in terms of energy intake.+ There was much variation in the first measurements, the lowest intakes being reported for FFB and Cookie 150 and the highest for Rice 150. The relative ranking at the beginning was maintained for the extreme groups at the end of the study though there was some shuffling for the middle groups. An important point brought out by Figure 5 is that all the groups improved in intake.

The general pattern seen in Figure 5 is repeated in Figure 6 for protein except that FFB shows a very large increase while Cookie 300 shows almost no change at all.

Figure 7 offers additional information about the pattern of changes in energy intakes. The values in Figure 7 are the means for individuals having data for initial and final diets and is therefore a more accurate estimate of changes in intake.++ The

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+ Because of poorer coverage at the final dietary measurement, sample sizes are greater at the initial than at the final points. The two end points therefore, in Figures 5 and 6, do not include the same number of individuals.

++In all Tables in this chapter, the values refer to the product of subtraction of final minus initial mean value for the group as a whole. Later in this report, the values for mean changes refer to and mean of difference in intake calculated for each individual (as in Table 34). Change estimates may therefore vary slightly.

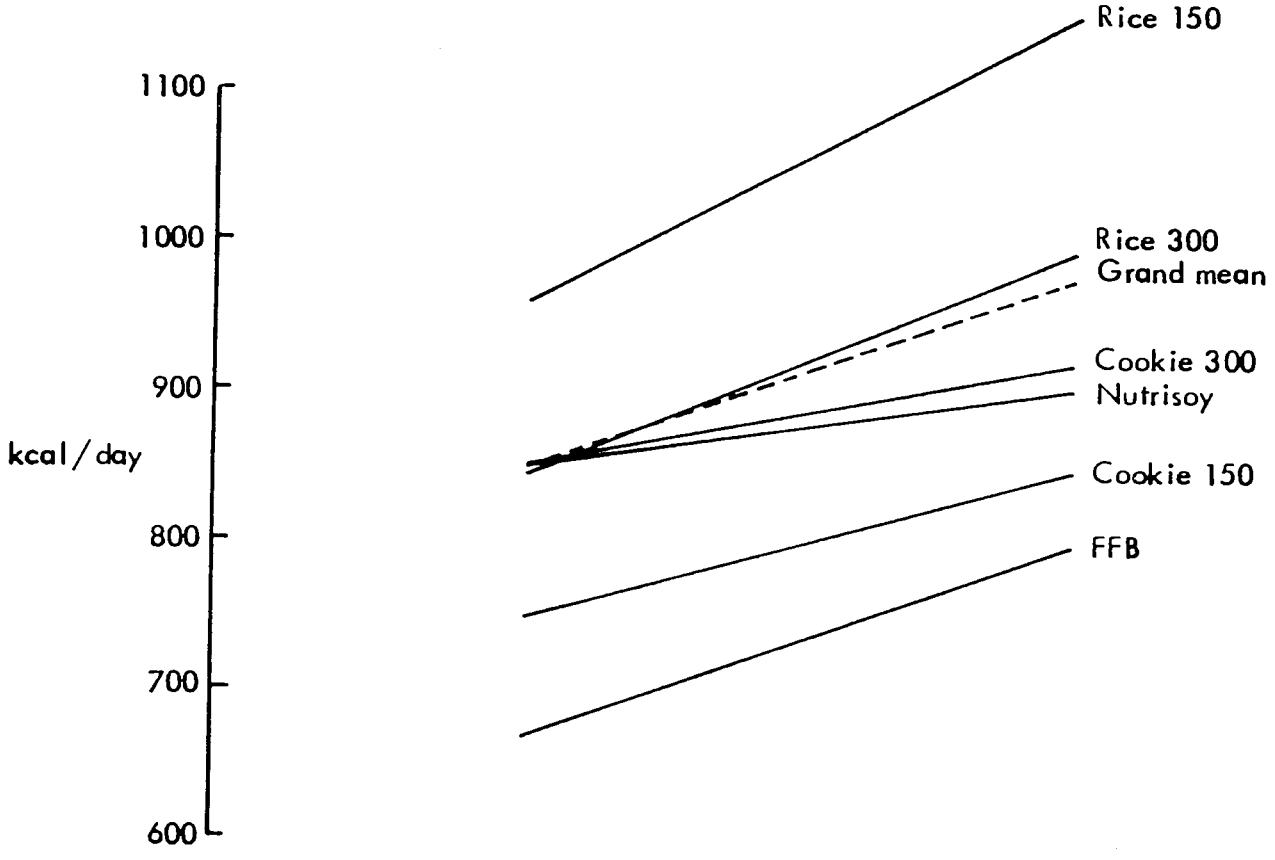


Figure 5 : Mean energy intakes (kcal / day) in the pre-experimental and experimental periods

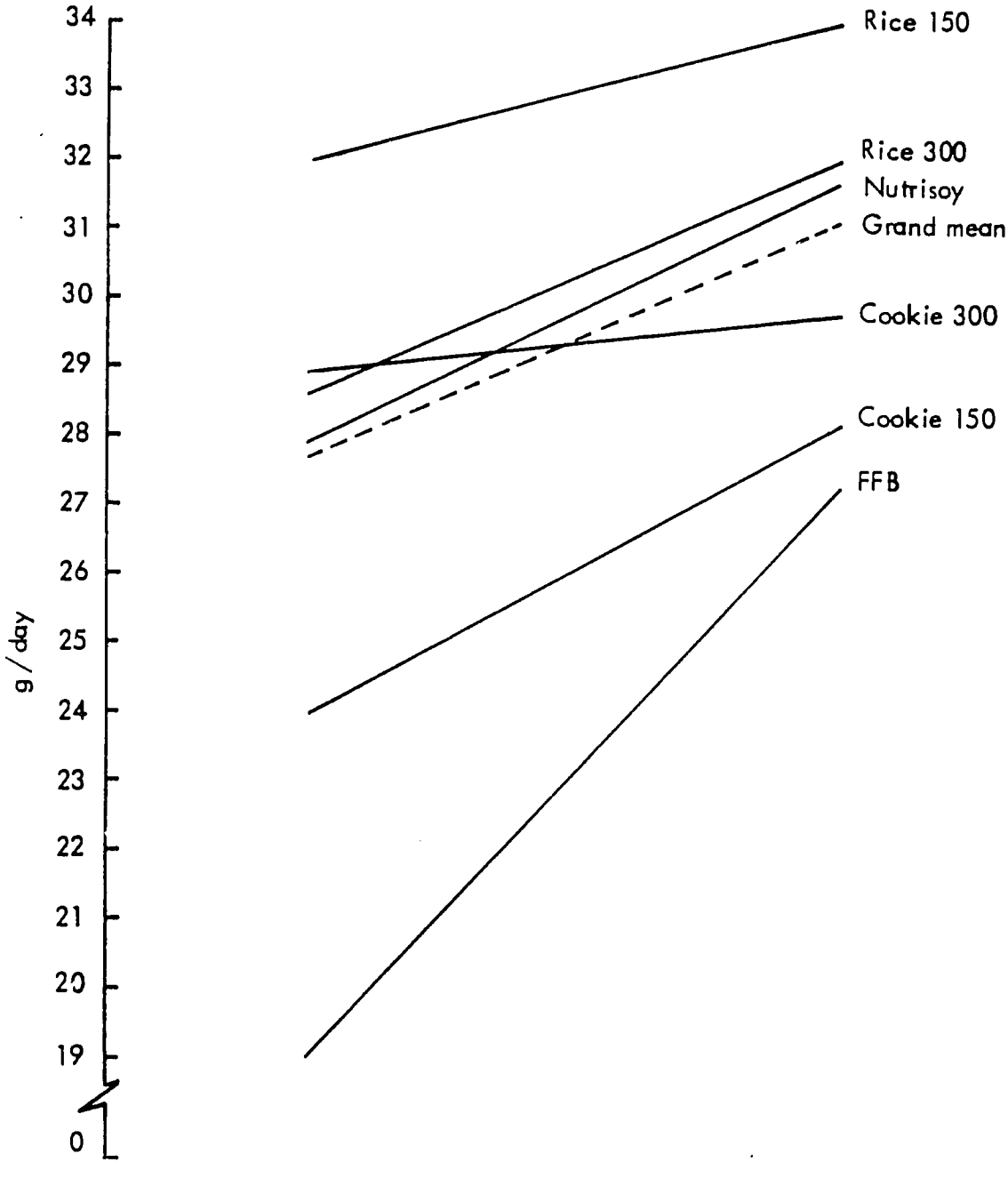


Figure 6 : Total protein intakes in pre-experimental and experimental periods

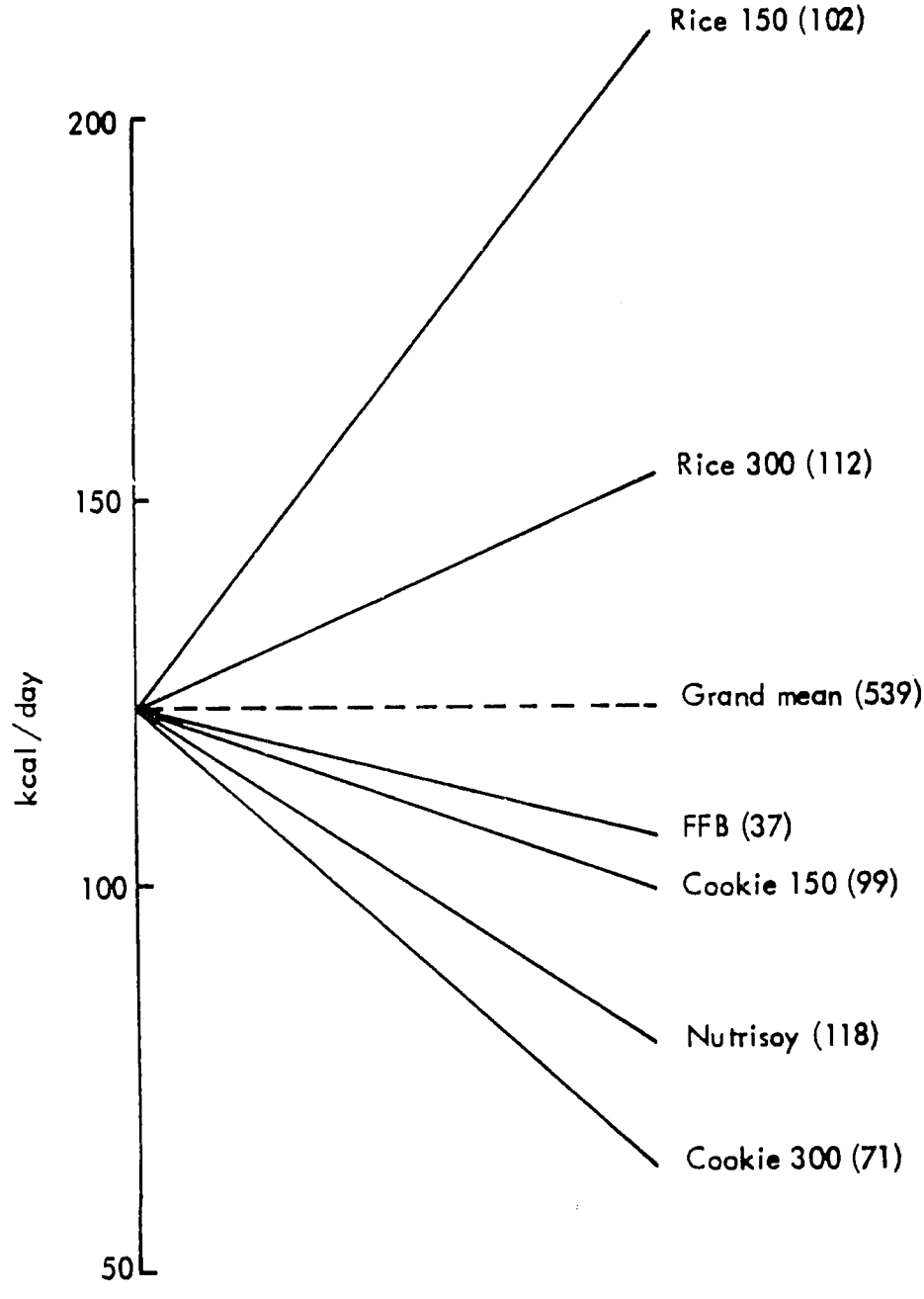


Figure 7 : Mean changes in total energy intakes
( ) sample sizes

graph tells us again that all groups showed an improvement in dietary intakes, the mean increased being a little over 120 kcal/day ($p < .001$). The relative rank has the two rice groups at the top with about 200 kcal for Rice 150 and 150 kcal for Rice 300, FFB and Cookie 150 with over 100 kcal and at the bottom, Nutrisoy and Cookie 300 with around 70 kcal. The improvements were significantly different from zero for Rice 150, Rice 300 and Cookie 150 ($p < .05$).

The question at this stage is whether the changes in total energy intakes are related to supplement consumption. These data are shown in Table 11. Overall, the association is clear. Children consuming more than 50 kcal/day of the supplements increased their intakes by 218 kcal while those consuming less than 50 kcal/day increased their intakes by 17 kcal ($t=4.6$, $p < .001$). For protein changes, the corresponding figures are 5.2 and 1.7 g respectively ($t = 2.0$, $p < .05$). The only group where the changes of the poorly supplemented group exceed those of the better supplemented is Rice 300.

The next four tables (12-15) explore whether the changes in intake vary by certain characteristics of the child. Table 12 presents the data for initial nutritional status. Children less than 80% of weight for age increased their energy intakes by about the same amount as children with WA values between 80 and 90%: that is, 105 kcal. per day. Children with weights greater than 90% of median, on the other hand, increased their intake by 150 kcal. The average increase was about 120 kcal. Therefore, it would appear that children who are better off in terms of WA tend to increase their diets by a greater amount than seen in those children who are worse off. This general pattern is evident for all but the Cookie groups.

Table 11: Changes in total energy and protein intake[1] by categories of food supplement consumption

Group	Energy (kcal/day)				Protein (g/day)			
	Supplemented[2]		Non-supplemented[3]		Supplemented[2]		Non-supplemented[3]	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	27	163	10	-54	27	7.48	10	3.30
Rice 150	66	371	36	-87	66	5.91	36	-3.83
Rice 300	77	126	35	212	77	1.65	35	8.69
Cookie 150	39	172	60	52	39	5.31	60	3.46
Cookie 300	38	180	33	-73	38	3.21	33	-3.79
Nutrisoy	35	268	83	0	35	12.20	83	2.23
All groups	282	218	257	17	282	5.23	257	1.71
Pooled SD	504				20.0			

1. Changes in total intakes: diet values during the intervention minus diet values prior to the intervention
2. Supplemented: consuming more than 50 kcal/day from the supplements
3. Non-supplemented: consuming less than 50 kcal/day from the supplements

Table 12:
Changes in total energy intakes (kcal/day)[1] by categories of nutritional status at the beginning of the intervention.

Group	< 80 WA		80-90 WA		> 90 WA		All children	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	15	61	14	63	8	259	37	106
Rice 150	26	220	45	196	31	222	102	211
Rice 300	26	126	38	88	48	219	112	153
Cookie 150	14	-21	44	185	41	48	99	99
Cookie 300	19	101	34	68	18	11	71	63
Nutrisoy	24	56	39	-18	55	159	118	79
All groups	124	104	214	107	201	151	539	123
Pooled S.D.	489		534		480		504	

1 Changes in total energy intakes: values during the intervention minus values prior to the interventions.

Table 13
Changes in total energy intakes[1] (kcal/day) by categories of age.

Group	≤ 12		> 12	
	n	$\bar{x}$	n	$\bar{x}$
FFB	6	272	31	72
Rice 150	21	476	81	141
Rice 300	29	200	83	137
Cookie 150	16	125	83	94
Cookie 300	19	115	52	43
Nutrisoy	26	137	92	63
All groups	117	215	422	97
Pooled S.D.	512		499	

1 Changes in total energy intakes: values during the intervention minus values prior to the interventions.

Table 14
Changes in total energy intakes (kcal/day)[1] by socioeconomic group

Group	Socioeconomic level 3		4		5	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	3	665	21	124	13	-54
Rice 150	15	569	74	137	13	208
Rice 300	12	412	55	179	44	49
Cookie 150	16	272	64	91	18	-21
Cookie 300	9	172	44	68	18	-6
Nutrisoy	20	31	83	84	15	114
All groups	75	293	341	113	121	44
Pooled S.D	607		472		506	

1 Changes in total energy intakes: values during the intervention minus values prior to the interventions.

Table 15: Changes in total energy intakes (kcal/day)[1] by participation in the government food intervention (GFI)

Group	GFI, yes[2]		GFI, no[3]	
	n	$\bar{x}$	n	$\bar{x}$
FFB	21	118	16	86
Rice 150	20	384	82	168
Rice 300	55	170	57	138
Cookie 150	27	-34	72	150
Cookie 300	43	59	28	67
Nutrisoy	47	92	71	71
All groups	213	119	326	125
Pooled S.D		504		

1. Changes in total energy intakes: values during the intervention minus values prior to the interventions.

2. GFI, yes: participationin GFI

3. GFI, no: non-participation in GFI

Table 13 shows for all groups combined, younger children (< 12 months) had larger increases in energy intake than older children (> 12 months) ($t = 2.2$, $p < .05$). For the total sample, the change in younger children was 215 kcal compared to 97 kcal in older children.

In general, as shown in Table 14, those of better socioeconomic status change their intakes by a larger amount. The changes were 293 kcal for the best off group, 113 kcal for the intermediate group and 44 kcal for the poorest group. (Contrast between category 3 and 5: $t = 3.0$, $p < .05$). Only in the Nutrisoy group was this pattern reversed.

Finally, Table 15 suggests that the overall changes in total energy intakes were similar for those participating or not in the government food intervention, 119 vs 125 kcal respectively. The pattern is quite variable, however, when examined by group.

Summary

In summary, dietary intakes were moderately different among groups at the beginning of the study. Over the course of the study, all groups showed increases in energy intakes and all but Cookie 300 showed increases in protein intakes. The changes were most pronounced for the Rice groups and least for Nutrisoy and Cookie 300. Younger, heavier, and better off children showed the greatest dietary increases. Participation in the government food intervention was not related to dietary changes.

6.3 Food supplement intake

The estimates of food supplement intake, it will recalled, are derived from the 24 hour recall dietary survey. All of the supplements except the FBB items were foods not normally consumed by the study children. For the FFB, which includes rice and beans, one must distinguish between normal and additional consumption. Since this was not done, the estimates of supplement consumption in FFB are probably overestimates.

This section focuses on two questions. First, did supplement consumption vary by group? Second, was supplement related to initial nutritional status, age of the children, socioeconomic status, and participation in the government food intervention.

The mean energy and protein intakes from the supplements are shown in Figure 8. The average energy intake from the supplements in all groups was about 90 kcal ($p < .001$). The relative rank of changes has the rice groups on top with around 120 kcal, FFB and Cookie 300 with a little over 100 kcal and Nutrisoy and Cookie 150 with less than 60 kcal. All of the values for energy were significantly different from zero ($p < .05$).+ For protein, the relative rank is reversed, as Nutrisoy, a high protein supplement, is the highest, with nearly 4 gs; FFB, Rice 150 and Rice 300 intermediate with nearly 2 g and Cookie 150 and Cookie 300 with about 1 g of protein. All of the values for protein, with the exception of those for Cookie 150, are significantly different from zero ($p < .05$).++

+ Rice 300 differs significantly from Cokie 150 and Nutrisoy ($p < .01$. Rice 150 is a so significantly different from Cookie 150 and Nutrisoy ($p < .01$)

++ Nutrisoy values are significantly different from all others except those of FFB ($p < .05$). Cookie 150 values differ statistically from all others except those of Cookie 300 ($p < .05$).

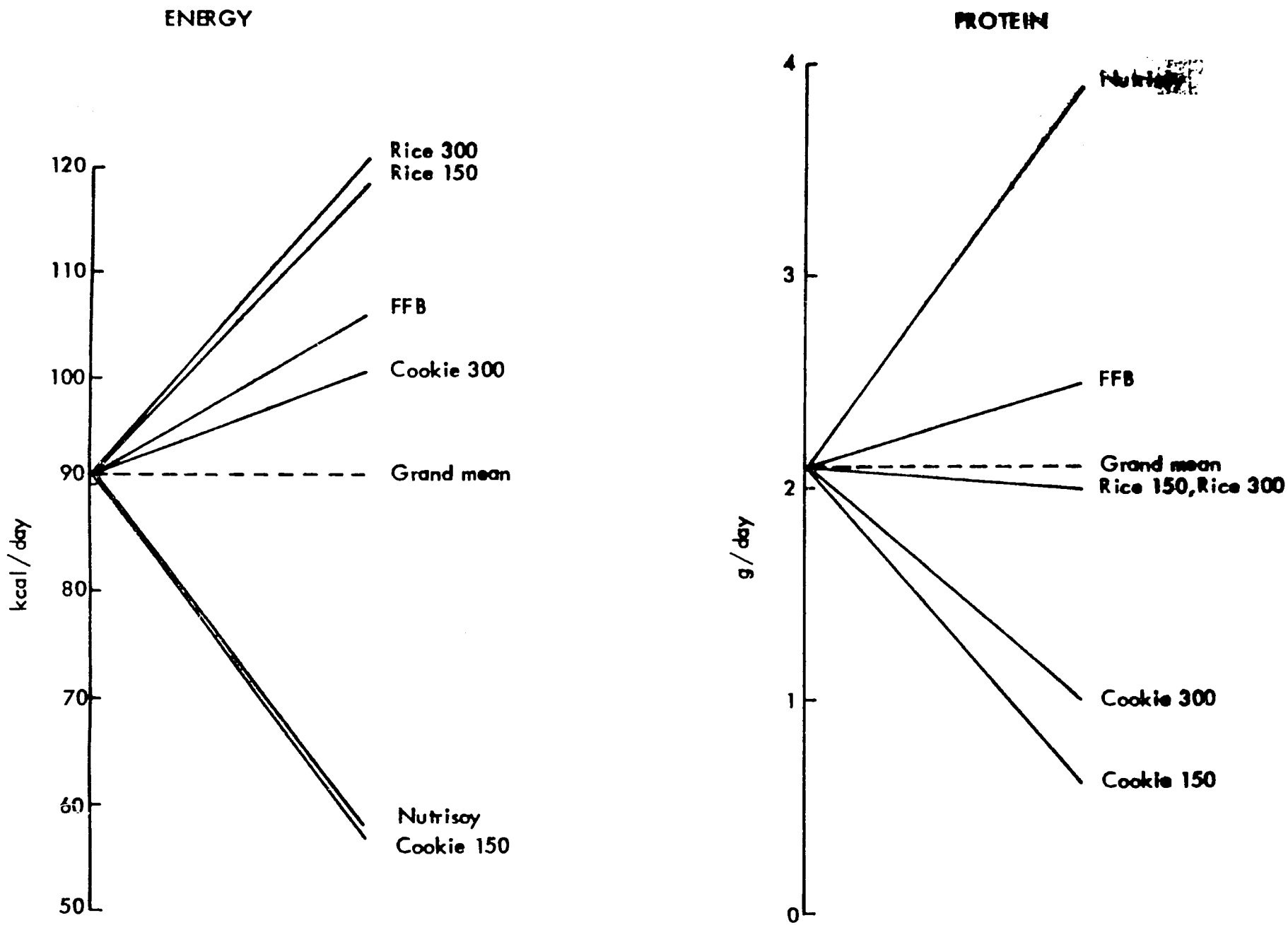


Figure 8 : Mean energy (kcal/day) and protein (g/day) intakes from the supplements

An interesting point is that intakes from the supplements for Rice 150 and Rice 300 are similar (e.g. differences between values are not significantly different). One would have expected twice the consumption in Rice 300 than in Rice 150. For energy, intakes for Cookie 300 are nearly doubled those of Cookie 150 (however the values are not statistically different) but for protein, they are very similar. This point is further analyzed in Figures 9 and 10 which show the distribution of cases by categories of energy intake from the supplements for the rice and the cookie groups. Again, the data in Figure 9 indicates that Rice 150 and Rice 300 are fairly similar. However, Cookie 150 and Cookie 300 show more of the differences one would have expected.

The next four tables, 15A to 18, explore whether the consumption of the supplements vary by initial nutritional status, age of the children, socioeconomic status, and participation in the government food intervention. Whereas the change in total energy intake differed by initial nutritional status, consumption of the supplement does not. Thus, in Table 15A, the energy supplement intake of all groups is 102 kcal for children with less than 80% WA, 80 kcal for those between 80-90% WA and 96 kcal for those over 90% WA.+ Nearly identical means are shown in Table 16, 89 kcal for all children less than 12 months and 91 kcal for all those over 12 months. Differences in energy supplement intake are also minor by socioeconomic level as shown in Table 17, 80 kcal per level 3, 91 kcal for level 4 and 99 kcal for level 5.

+ There is thus no clear pattern. Differences between children with weight for age values less than 80% and those with WA values between 80 and 90% are however statistically significant ($t = 3.2$, $p < .05$).

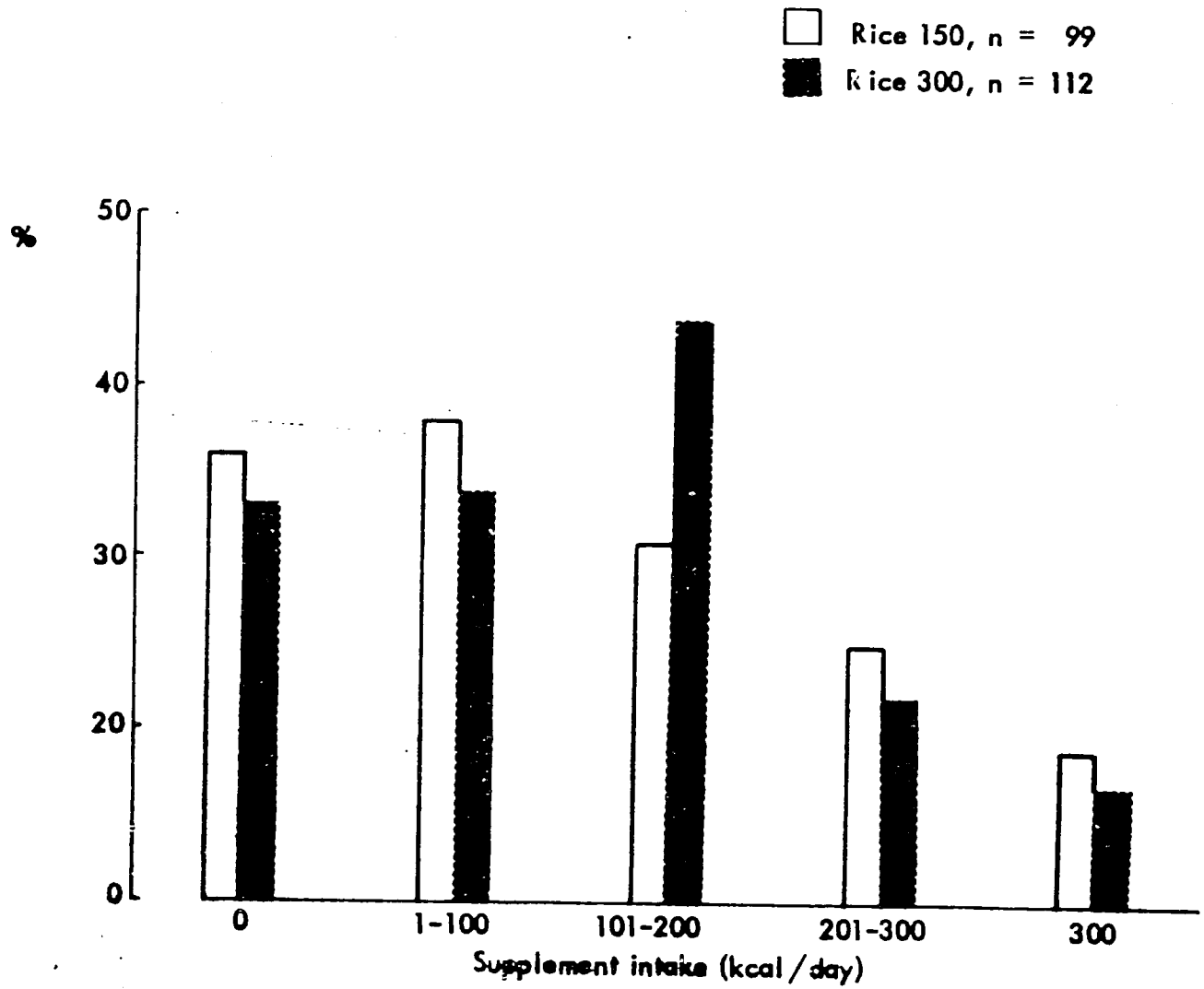


Figure 9 : Distribution of energy intake (kcal / day) from the supplements in two groups : Rice 150 and Rice 300

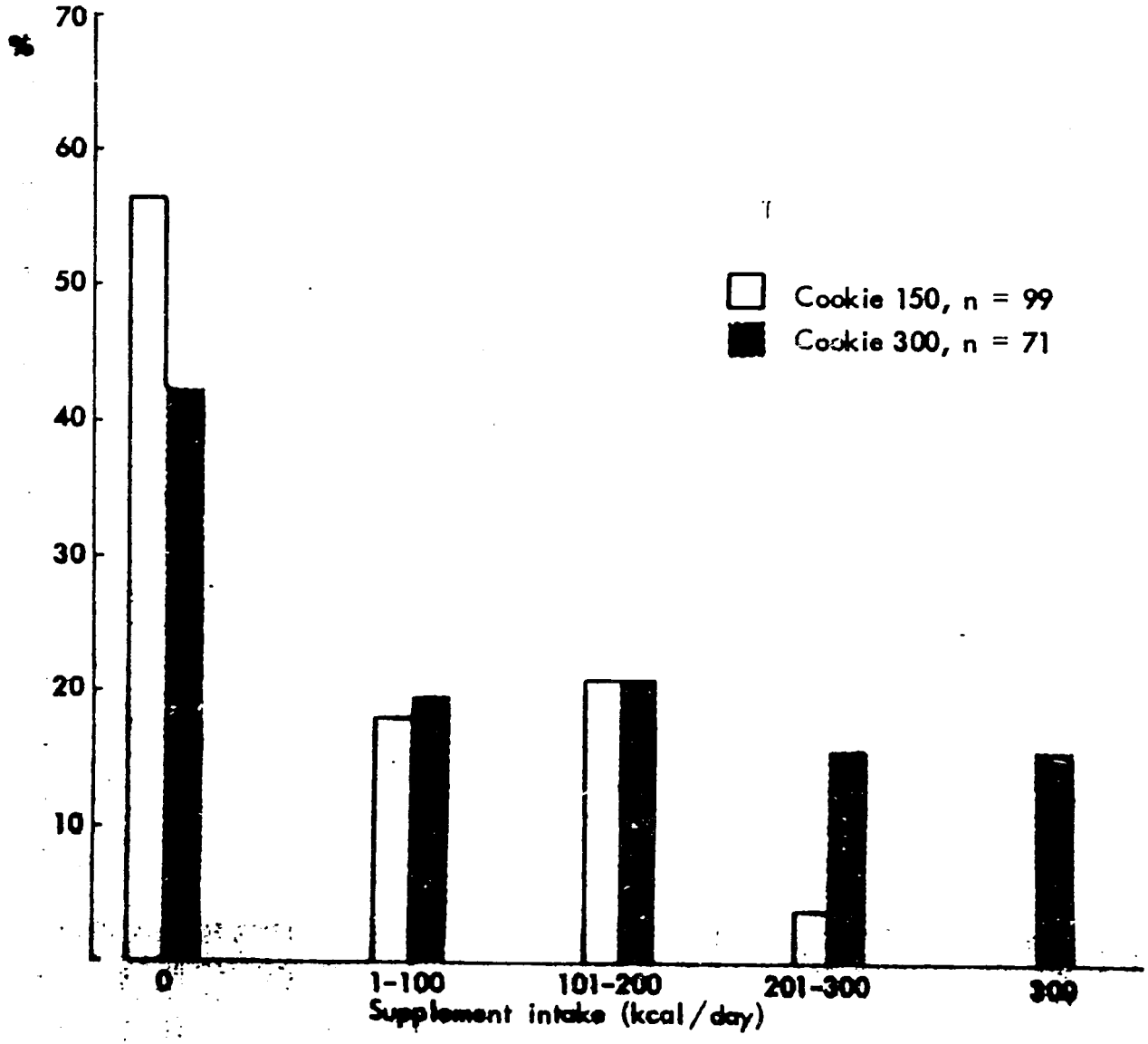


Figure 10 : Distribution of energy intake (kcal / day) from the supplements in two groups : cookie 150 and cookie 300

Table 15A: Food supplementation intake (kcal/day) by category of nutritional status at the beginning of the intervention

Group	< 80 WA		80-90 WA		> 90 WA	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	15	94	14	129	8	90
Rice 150	27	125	45	107	31	127
Rice 300	26	119	38	102	48	136
Cookie 150	14	34	44	62	43	61
Cookie 300	19	151	34	75	18	96
Nutrisoy	25	63	40	34	55	72
All groups	126	102	215	80	203	96
Pooled S.D.	110		103		124	

Table 16
Food supplement intake by age

Group	≤ 12 months		> 12 months	
	n	$\bar{x}$	n	$\bar{x}$
FFB	6	73	31	112
Rice 150	21	135	82	113
Rice 300	29	123	83	120
Cookie 150	17	40	84	61
Cookie 300	19	83	52	107
Nutrisoy	26	54	94	59
All groups	118	89	426	91
Pooled S.D.	103		116	

Table 17
Food supplement intake by socioeconomic status

Group	Socioeconomic level 3		4		5	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	3	91	21	108	13	107
Rice 150	15	111	75	125	13	87
Rice 300	12	71	55	130	44	126
Cookie 150	16	50	65	61	19	56
Cookie 300	9	145	44	87	18	113
Nutrisoy	21	58	84	56	15	63
All groups	76	80	344	91	122	99
Pooled S.D	97		117		111	

Table 18: Food supplement intake (kcal/day) by participation in the government food intervention

Group	GFI, yes		GFI, no	
	n	x	n	x
FFB	21	106	16	106
Rice 150	20	104	83	121
Rice 300	55	108	57	133
Cookie 150	27	45	74	62
Cookie 300	43	94	28	112
Nutrissy	48	43	72	67
All groups	214	82	330	97
Pooled S.D		113		

Also, supplement consumption does not appear to be markedly influenced by participation in the government food intervention as seen in Table 18: overall intakes were 82 kcal for participants and 97 kcal for non-participants. It will be recalled that the government food intervention also was unrelated to the changes in total nutrient intakes.

Summary

In summary, supplement intake was greatest for the rice groups (about 120 kcal), intermediate for FFB and Cookie 300 (about 100 kcal) and least for Nutrisoy and Cookie 150 (less than 60 kcal). On the other hand, Nutrisoy contributed the most in protein, nearly 4 grams per day, because of its high protein concentration. As expected, more of the Cookie was consumed when the amount was doubled from 150 to 300 grams per day. However, doubling the amount of Rice did not incease consumption. Supplement intake did not appear to be related to any of the factors examined: initial nutritional status, socioeconomic status, age of the children, and participation in the government food intervention.

6.4 Measures of Acceptability

Measures of acceptability of the supplements are shown in Table 19. The first column gives the percent of mothers reporting consumption of the supplement by the child (yes/no) in the 24 hour recall survey. The supplements most consumed, according to this measure, are the rice supplements with nearly 75% of cases being consumers. The cookie groups were intermediate, and Nutrisoy is the lowest with 30% of cases. For the FFB, not shown in Table 18, the percent of consumers is 78%. All supplements are said to be disliked by only a low percentage of children, Nutrisoy being at the extreme with 13% of dislikers. (column 2). About 15% of the mothers considered they needed more of the rice and cookies but only 9% felt they could use more Nutrisoy (column 3). Interestingly, there were no differences in the perceived adequacy of the amounts given associated with level of supplementation (Rice 300 vs Rice 150; Cookie 300 vs Cookie 150). Column 4 presents data about an important aspect, the percent of households with very low stocks of the supplement defined as between 0 and 20% of stocks). The higher the percentage, the greater the use and presumably the greater the acceptability of the product. About 80% of the households receiving cookies had low stocks compared to about 60 percent of households receiving rice cereal. The lowest again is Nutrisoy; only 40% of households had low stocks. The last column presents data about the percent of "families liking" the supplements. The intent here was to assess indirectly the popularity of the product in family members other than the child.

Table 19: Measures of acceptability of the supplements: analysis of five indices (see footnotes for the definition)

Groups	1	2	3	4	5
Rice 150	73.7	4	14	57	60
Rice 300	76.8	6	14	62	44
Cookie 150	43.4	7	15	86	55
Cookie 300	57.7	6	15	80	79
Nutrisoy	30.5	13	9	40	74

1. Percent reporting at least some consumption of the supplements in the 24-hour recall survery.

2. Percent of children not liking the supplements; based on mother's reports.

3. Percent of mothers who consider that the quantity of supplement they were given was too low.

4. Percent of households with very low stocks of the supplements (i.e. between 0 and 20% of the original amount issued); based on observation.

5. % of families reporting liking the supplement; based on mother's reports.

(This does not necessarily mean that they did consume the supplements.) A high percentage of families reported liking the supplements. Differences among groups are not easy to fit into a pattern. The rice groups have an average value slightly over 50%. The cookie groups include one of the highest values (79% for Cookie 300) and one of the lowest (55% for Cookie 150). Nutrisoy is the second highest with 74 of families "liking" the product.

The findings suggest that Rice Cereal has both highest consumption and highest acceptability for children. It also does better than Cookie in terms of not being consumed by other family members as suggested by disappearance of stocks.

6.5 Replacement

The situation normally encountered in food supplementation studies is that the reported consumption of the supplement is more, sometimes by a considerable amount, than the amount by which the total diet changed. This occurs because in consuming the supplement, subjects usually eat less of other foods in their diet. One speaks, therefore of "replacement". For example, if the supplement provided 150 kcal but the total diet increased by only 50 kcal, one can say that 100 kcal of the supplement were replaced 100 kcal of the usual diet. The ratio of the net change to the mean supplement intake (50/150 = .33) can serve as an indicator of replacement. The higher the ratio, the less the level of replacement and a value of 1 would indicate no replacement at all.

A similar exercise was attempted with the data from this study. These data are shown in Table 20 for energy and Table 21 for protein. The columns of interest are net change, the increase in the total diet, and supplement intake. It is evident that for most of the groups, the change in the total diet is greater than

Table 20: Mean energy intake (kcal/day) in the experimental groups

Groups	Initial			Final			Net change			Supplement			Ratio
	n	x	SD	n	x	SD	n	Δ	SD	n	S	SD	(Δ/S)
FFB	48	676	676	37	799	306	37	104	464	37	106[c]	85	0.98
Rice 150	103	959	620	103	1149	698	101	190[c]	615	102	118[c]	123	1.61
Rice 300	122	843	421	112	995	442	112	153[b]	497	112	121[c]	119	1.26
Cookie 150	112	750	368	101	852	550	99	99[a]	99	101	57[c]	77	1.74
Cookie 300	77	850	415	71	922	440	71	62	535	71	101[c]	121	0.61
Nutrisoy	131	852	381	120	903	363	117	66	422	120	58[c]	112	1.14
Total	608	846	452	547	973	511	539	122[c]	464	544	91[c]	113	1.34

+ The values for net change given in this table are means of cases having complete information, that is, both initial and final dietary values. The means given here for initial and final diets include all available data at either period. For this reason, the difference between the means for final and initial values do not correspond exactly to the valued given for net change. This same comment applies to Table 21. "t" tests assess whether the means are significantly different from zero.

a. $p < .05$, using the pooled standard deviation
b. $p < .01$, using the pooled standard deviation
c. $p < .001$, using the pooled standard deviation

Table 21: Mean protein intake (g/day) in the experimental groups

Groups	Initial			Final			Net change			Supplement			Ratio
	n	x	SD	n	x	SD	n	Δ	SD	n	S	SD	(Δ/S)
FFB	48	19.1	11.7	36	27.2	11.8	38	6.4	15	37	2.5[c]	1.8	2.6
Rice 150	117	32.0	19.4	103	34.0	17.8	101	2.5	21	101	2.0[c]	2.1	1.3
Rice 300	121	28.6	18.4	112	32.2	20.6	112	3.9	25	112	2.0[c]	2.0	2.0
Cookie 150	112	24.0	15.3	102	28.2	15.3	99	4.2[a]	20	101	0.6	0.9	7.0
Cookie 300	77	28.9	18.6	72	29.8	15.3	79	-.04	22	71	1.0[a]	1.2	0.0
Nutrisoy	131	27.9	17.2	120	31.7	17.4	118	5.2[b]	20	120	3.9[c]	7.8	1.3
Total	607	27.7	17.7	546	31.1	17.3	538	3.6	21.3	544	2.1[c]	4.1	1.7

"t" tests that the means are significantly different from 0

a $p < .05$, using the pooled standard deviation
b $p < .01$, using the pooled standard deviation
c $p < .001$, using the pooled standard deviation

the supplement consumption. The last column of Tables 20 and 21 shows the ratio of the change in the total diet to the supplement contribution. For energy, (Table 20) it is higher than 1, particularly for Cookie 150 and for Rice 150. It is lower than 1 on the other hand, for Cookie 300. For protein (Table 21) all the ratios are higher than 1 except for Cookie 300, a group where the total protein intakes did not change. The pattern is perhaps clearer in Figure 11 which is a plot between changes in energy intakes and the supplement contribution. The solid line represents the theoretical relationship for a perfect supplement, that is, with no replacement. The area below the line would imply, in conventional analysis, that the supplement replaced part of the usual diet. The area above the line represents a situation in which the change in diet is greater than the supplement contribution. All but two of the groups fall in this last category.

Summary

In summary, the analysis of replacement rates yields the paradoxical result that the changes in total diet are larger than the consumption of the supplement for Rice 150, Cookie 150, Rice 300 and Nutrisoy, equal to supplement consumption for FFB and less than supplement consumption only for Cookie 300. We will come back to this issue in the discussion, but the probable explanation is that the children obviously aged (2 months, see Figure 2) between initial and final assessments. Being older, children consumed more food at the end of the study than at the beginning. This means in effect, that we can not measure replacement directly because of age. On the other hand, the replacement index provides a relative measure of replacement and thus would indicate least replacement for Cookie 150 and Rice 150, intermediate replacement for Rice 300, Nutrisoy and FFB, and the most replacement for Cookie 300.

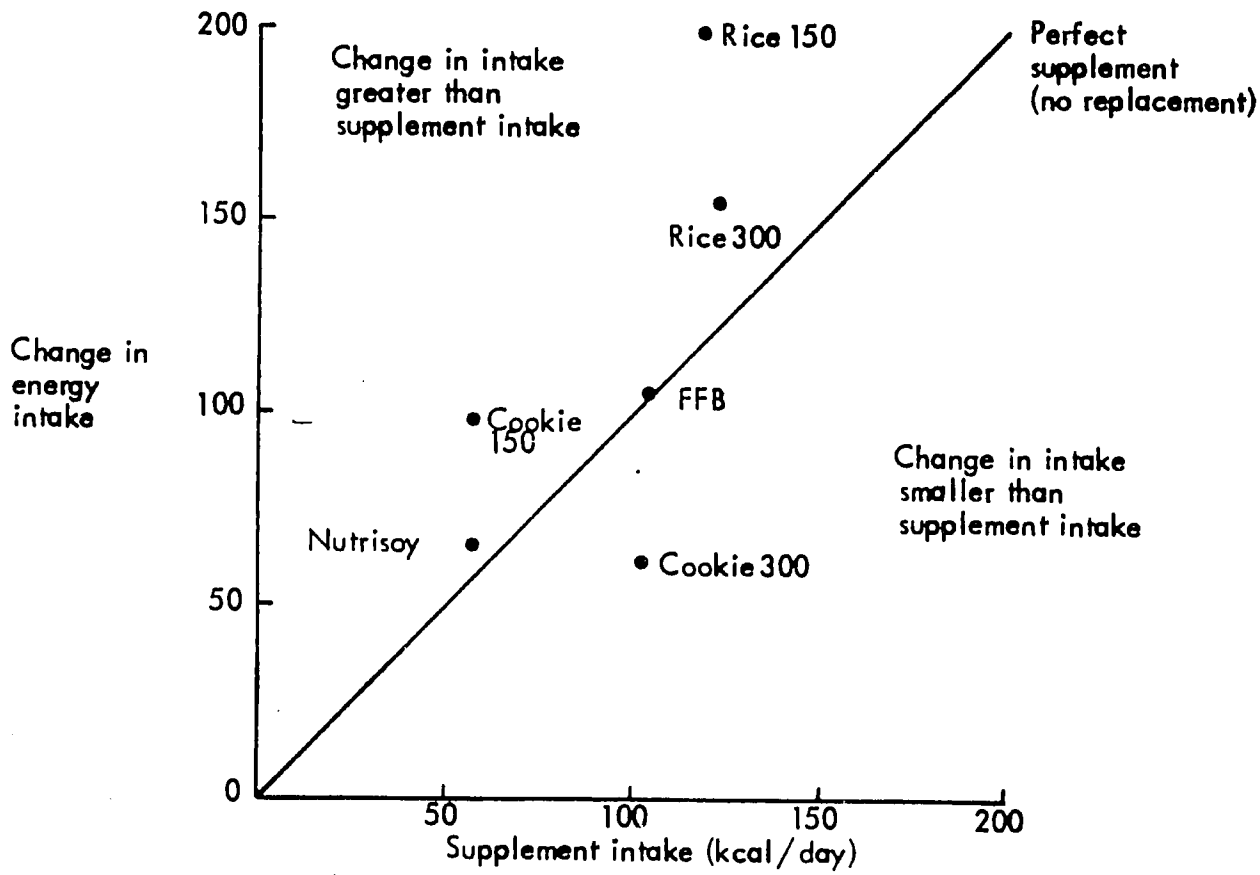


Figure 11: Relationship between change in energy intakes and supplement intake

6.6 Anthropometry

The intervention period lasted four months. Anthropometric information was available, it will be recalled, for height, weight for height and weight for age. In this section we first ask whether there have been changes in the anthropometric variables from the beginning to the end of the experimental period. Next, we ask whether these changes are a function of supplement intake, age and initial nutritional status.

6.6.1. Analysis of Mean Changes in Anthropometry

The basic information is given in Figure 12. It shows three figures, one each for weight for age, weight for height and height for age. For each figure, the beginning of the line corresponds to the initial status for the variable in question and the end of the line represents the final status for the same variable. Two aspects are apparent in Figure 12. First, the different experimental groups have very different starting points, particularly the Family Food Basket (FFB) group which is the lowest. Second, most of the experimental groups improved in at least one variable. The extent of improvement in each of the experimental groups is best seen in Figure 13 which shows mean changes in the anthropometric variables. Changes are more frequently positive and larger for weight for age than the other other anthropometric variables. The groups that improved the most in weight for age, FFB, Rice 150 and Cookie 300, were also the ones

that began the worst.+ Cookie 150, one of the highest groups at the initial period, actually became worst. The same conclusion is evident for weight for height, those worst off improved the most. Rice 300, the highest in weight for height, actually decreased though still remained as the highest at the end of the experiment at a value similar to that found in well-nourished children.++ Changes in height were negative in four groups, Cookie 150, Nutrisoy, Cookie 300 and Rice 150. These groups were also the ones beginning with greater height for age values. The only two groups that improved, Rice 300 and FFB, were the ones initially the lowest. The changes in height are so minimal, whether positive or negative, that no more analyses

+ Changes in WA were statistically significant for FFB, Rice 150, Rice 300 and Cookie 300. Nutrisoy and Cookie 150 were significantly different from the rest of the groups and Rice 300 and FFB differed significantly ($p < .05$).

++ Changes in WH were statistically significant for FFB and Rice 150 ($p < .05$) Values for FFB were different from those of Rice 300 and Cookie 150 ($p < .05$) Rice 150 values also differed from those of Rice 300, Cookie 150, Cookie 300 and Nutrisoy ($p < .05$).

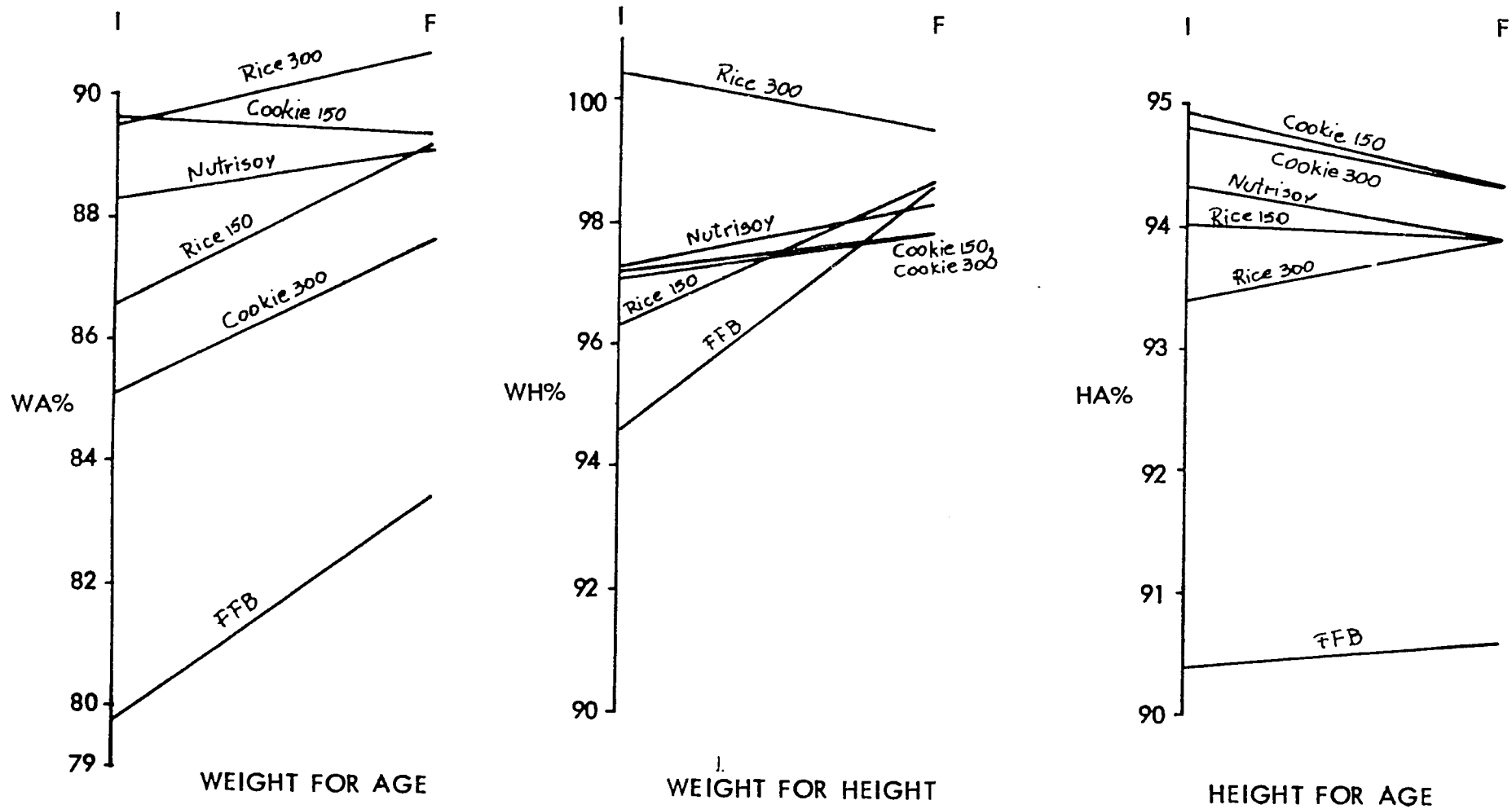
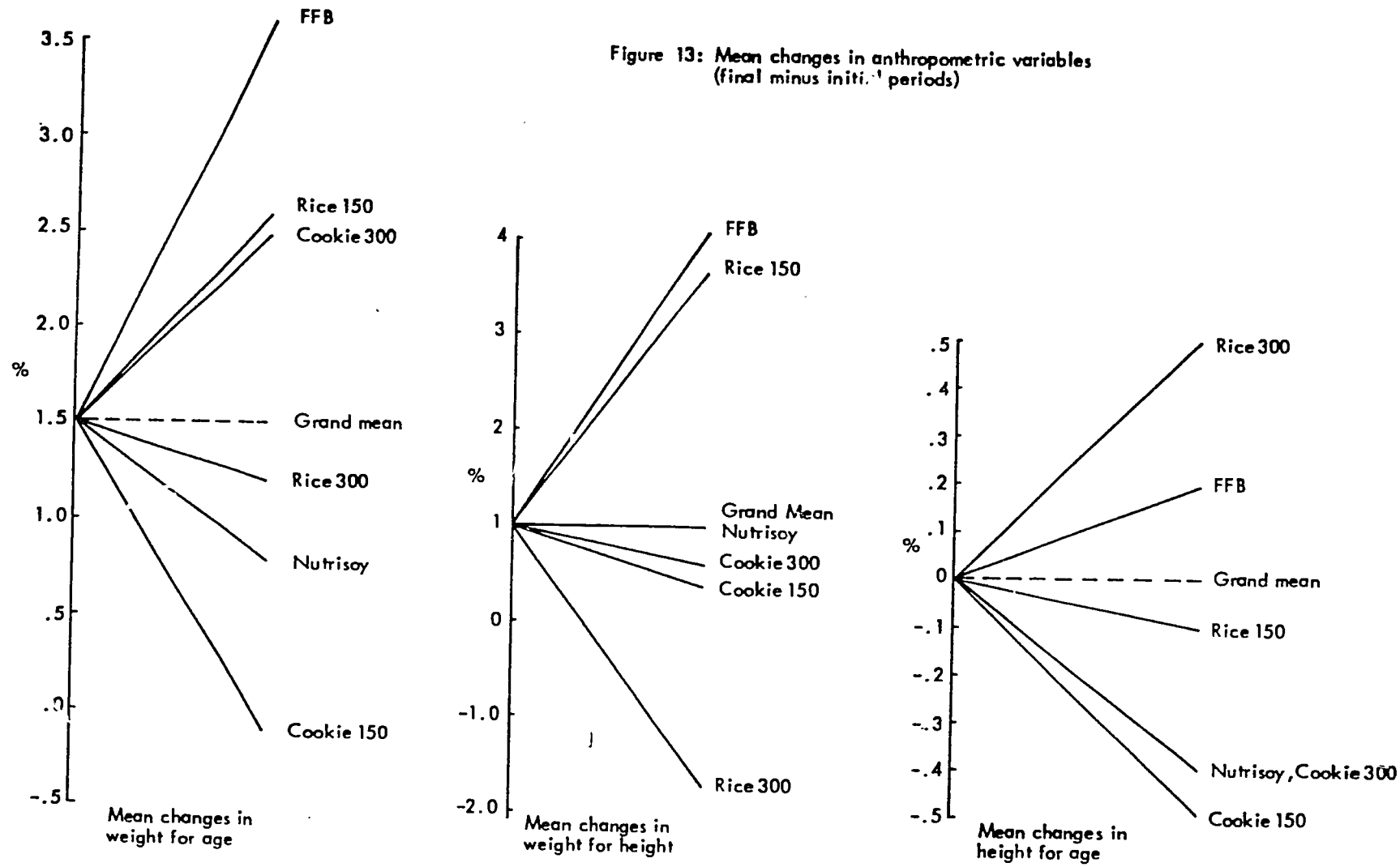


Figure 12: Anthropometric values at the initial (I) and final periods (F)

Figure 13: Mean changes in anthropometric variables (final minus initi.[1] periods)



[1] Note the scales are different. Percent of median values are not comparable across anthropometric variables.

are presented about them in the rest of this report though these analyses were carried out.

Figure 12 and 13 strongly suggest that initial status is a key determinant of change. This is explored in greater detail in Table 22 (for categories of weight for age) and in Table 23 (for categories of weight for height). The pattern is clear for both variables. For weight for age (Table 22), the group as a whole had the following changes: 4.1% for children less than 80% WA, 1.7% for those between 80 and 90% and -0.3% for those over 90% WA. For weight for height (Table 23), those below 90% increase by an average of 65% while those above 90% WH increased by only 0.12%.

Table 22 and 23 also provide additional information about the relative performance of each group. One can ask the following questions. a) If one considers only children with poor nutritional status, is the problem of lack of comparability avoided? and b) what is the anthropometric response in each of the groups when only children of poorer nutritional status are considered? To answer these questions, the pertinent information is taken from Tables 22 and 23 and presented in Table 23a (where the information for those with WA less than 80% is shown on the left and for those with WH less than 90% is shown on the right). It should be noted that weight for age is generally recognized as a more appropriate indicator of nutritional status in Costa Rica than weight for height. The reason is that weight for height values are close to normal in most children while weight for age values are often low.

These data show the following:

a) Sample sizes are much reduced when only the children of poorer nutritional status are considered.

b) The comparability of the groups is substantially improved when only the extreme cases are considered. Some differences do remain however.

c) All groups improve but not to the same degree. Almost all changes are significantly different from zero (i.e. indicating that changes did occur). The data suggest that in terms of weight for age, FFB and Rice 150 improved the most. For weight for height, the largest changes are for FFB. Overall, FFB had the best performance in WA and WH while Cookie 150 had the poorest. Again, the lack of a control group prevents us from isolating the portion of the changes that would have occurred naturally, that is, without the interventions.+ However, the differences between groups do suggest that degree of change did vary as a function of type of supplement.

The mean changes in anthropometry were similar for children with low and high supplementation (less or more than 50 kcal/day). This issue is explored in greater detail in section 6.7.2.

The mean changes in anthropometry were not strongly related to age. Table 24 shows the % change in weight for age, for children 0-9, 10-11 months and over 11 months of age. Overall, children over 11 months increased by 2% in WA while younger children did not change. However, this pattern is quite variable by experimental group.

6.6.2. Changes in the Prevalence of Malnourished Children.

An alternative approach to measuring change in anthropometric variables is in terms of changes in the prevalence of

+ a well known phenomenon in statistics and epidemiology is "regression to the mean". If one picks a group which is low for a particular level (e.g. low vitamin A values), chances are that upon remeasurement, the group will score substantially higher in that measure.

Table 22: Mean anthropometric changes in weight for age by categories of initial nutritional status (pooled S.D. = 5.3)

Group	<80 WA						80-90 WA						>90 WA					
	I		F		Δ		I		F		Δ		I		F		Δ	
	N^I	$\bar{X}$	N^F	$\bar{X}$	N	$\bar{X}$	N^I	$\bar{X}$	N^F	$\bar{X}$	N	$\bar{X}$	N^I	$\bar{X}$	N^F	$\bar{X}$	N	$\bar{X}$
FFB	23	68.9	23	75.0	23	6.9	17	83.9	17	86.1	17	2.2	10	97.8	10	98.0	10	0.2
Rice 150	33	72.0	33	77.2	33	5.2	51	86.0	51	87.3	51	1.3	39	99.7	39	101.9	39	2.2
Rice 300	28	73.0	28	76.6	28	3.6	43	85.9	43	88.2	43	2.3	54	100.9	54	100.1	54	-0.8
Cookie 150	16	74.5	16	76.6	16	2.1	49	85.6	49	85.5	49	-.04	51	98.2	51	97.2	51	-.96
Cookie 300	22	71.4	22	75.1	22	3.7	37	85.4	37	89.1	37	3.7	20	99.8	20	98.7	20	-1.05
Nutrisoy	28	73.4	28	76.5	28	3.1	54	84.9	54	86.4	54	1.5	65	97.7	65	96.9	65	-0.7
All groups	150	72.2	150	76.2	150	4.1	251	85.4	51	87.1	257	1.7	239	99.0	239	98.7	239	-0.3

Table 23: Mean anthropometric changes in weight for height by categories of initial nutritional (pooled S.D. = 5.5) status.

Group	Weight for height (WH) < 90 WH						Weight for height (WH) > 90 WH					
	I		F		Δ		I		F		Δ	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
FFB	13	83.0	13	97.5	13	14.5	37	98.5	37	98.9	37	.43
Rice 150	27	85.6	27	90.9	27	5.3	96	99.3	96	102.6	96	3.21
Rice 300	13	86.2	13	91.4	13	5.2	112	102.1	111	100.5	112	-2.5
Cookie 150	11	86.7	11	89.7	11	3.0	105	98.4	105	98.6	105	.17
Cookie 300	13	83.7	13	90.3	13	6.6	66	99.7	66	99.2	66	-.55
Nutrisoy	19	83.6	19	89.2	19	5.5	128	99.3	128	99.7	128	.34
All groups	96	84.8	96	91.3	96	6.5	544	99.7	543	100.0	543	.12

Table 23a Anthropometric changes in children of poor nutritional status

Group	Sample with less than 80%			Sample with WH less than 90%		
	Cases	Initial Status	Change+	Cases	Initial Status	Change++
FFB	23	68.9	6.1+++	13	83.0	14.5+++
Rice 150	33	72.0	5.2+++	27	85.6	5.3+++
Rice 300	28	73.0	3.6++	13	86.2	5.2++
Cookie 150	16	74.5	2.1 NS	11	86.7	3.0 NS
Cookie 300	22	71.4	3.7++	13	83.7	6.6+++
Nutrisoy	28	73.4	3.1++	19	83.6	5.5++
All groups	150	72.2	4.1+++	96	84.8	6.5+++

"t" tests that the means are significantly different from 0

++ $p < .01$
+++ $p < .001$
NS not siginificant

\+ Comparisons of weight for age changes revealed the following statistically significant differences between groups ($p < .05$)
- Cookie 150 differed from all groups except Nutrisoy
- Nutrisoy differed from FFB and Rice 150
- Rice 300 differed from FFB and Rice 150
- Cookie 300 differed from FFB

++ Comparisons of weight for height changes revealed the following statistically significant differences between groups ($p < .05$)
- FFB differed from the rest of the groups.

Table 24: Mean anthropometric changes in weight for age by categories of age (months)

Group	AGE 0-9 months						AGE 10 - 11 months						AGE >11 months					
	I		F				I		F				I		F			
	n	x	n	x	n	x	n	x	n	x	n	x	n	x	n	x	n	x
FFB	7	77	7	81	7	4	4	84	4	85	4	1	39	80	39	84	39	4
Rice 150	11	86	11	92	11	6	11	92	11	93	11	1	101	86	101	88	101	2
Rice 300	10	100	10	94	10	-6	18	93	18	93	18	0	97	88	97	90	97	2
Cookie 150	7	96	7	92	7	-4	9	100	9	97	9	-3	100	88	100	89	100	1
Cookie 300	8	85	8	90	8	5	9	91	9	91	9	2	62	85	62	87	62	2
Nutrisoy	8	91	8	87	8	-4	12	96	12	94	12	-2	127	87	127	89	127	2
All groups	51	90	51	90	51	0	63	93	63	93	63	0	526	86	526	88	526	2
Pooled SD										5.3								

malnourished children. The previous analyses in section 6.6.1. suggested that those with a poor initial status had greater changes in WA and HA.

We have used an indicator, changes in the "stock: of malnourished children to evaluate the impact of nutrition interventions (Table 25a). This indicator is the percent of children who were in the low category at the beginning of the study who move upwards into the next category. In Table 25a, the criterion values used were less than 90% WH and less than 90 WA. Table 25 suggests that all groups improved.

Other analyses are presented in Table 25b for the variable weight for age. These refer to the percent of children who shift from a higher to a lower category (i.e below 90% WA on the left of Table 25b and below 80% WA on the right of Table 25b). The percent of children moving down in status is smaller than that of children improving in status.

Table 25a: Changes in the stock of malnourished children in each of the experimental groups. Malnutrition defined as < 90% weight for height. and < 90% weight for age.

Experimental Group	Initial Number Below 90%		Number Moving to Normal+		% Change in the Stock++	
	W/H	W/A	W/H	W/A	W/H	W/A
FFB	13	38	9	9	69	24
Rice 150	27	76	17	25	63	34
Rice 300	13	67	8	22	62	33
Cookie 150	11	60	7	12	64	20
Cookie 300	13	56	7	18	54	32
Nutrisoy	19	78	10	18	52	21

+ Normal defined as over 90% WH or 90% WA.
++ Defined as improved over initial cases X100.

Table 25b Deterioration in Nutritional Status according to W/A category

Experimental group	W/A > 90%		80 < initial W/A < 90	
	Initial Number over 90 W/A	Moving below 90% W/A	Initial Number between 80 & 90% W/A	Moving below 80% WA
FFB	12	0.0	15	6.6
Rice 150	45	2.2	44	11.0
Rice 300	58	3.5	36	2.6
Cookie 150	56	12.5	43	14.0
Cookie 300	23	8.7	34	6.0
Nutrisoy	69	8.7	50	4.0

Another approach, much used in nutritional evaluations is the change in the prevalence of "malnourished" children as shown in Table 26. Here the indicators are the percent of children with values less than 80% WA and similarly, values with less than 90% WH, the commonly used cut-off points. This approach takes into account the initial number of "malnourished" children and also those who become "malnourished" in the population. The results do show improvements but not in all groups. For weight for age, FFB and the rice groups show improvements while the other groups, Nutrisoy, Cookie 150, and Cookie 300, do not. In terms of weight for height, the cookie groups do not improve but the Nutrisoy group does.

Summary

The section on changes in anthropometric measures indicates the following. There appears to have been statistically significant improvements in the nutritional status of most of the study groups. The groups did vary in the extent to which they changed. Figures 12 and 14 suggest that those groups which were initially worst off improved the most. For weight for age, FFB, Rice 150, Rice 300 and Cookie 300 were the most improved and for weight for height, the groups that improved were FFB and Rice 150. Other analyses corroborated that initial nutritional status was a good predictor of change. Changes in the prevalence of malnourished children (variously defined) also showed that there was general improvement. The groups improving the most were FFB and the rice groups. Finally the changes in height for age were too minimal to warrant further investigation

Table 26: Changes in the prevalence of malnourished children (WA < 80%).

Experimental Group	Weight for age < 80%			Weight for height < 90%		
	I WA	F WA	% Reduction (FWA-IWA/IWA)	I WA	F WA	% Reduction (FWH-IWH/IWH)
FFB (n=50)	46.0	30.0	35	26.0	12.0	54
Rice 150 (n=123)	26.8	20.3	24	22.0	15.4	30
Rice 300 (n=125)	22.4	15.2	32	10.4	5.6	46
Cookie 150 (n=116)	13.8	13.8	0	9.5	9.5	0
Cookie 300 (n=79)	27.8	26.6	4	16.5	96.4	0
Nutrisoy (n=147)	19.0	17.7	7	12.9	8.8	32

Where I is the initial percentage of malnourished children
F is the final percentage of malnourished children
WA is weight for age
WH is weight for height

6.7 Multivariate Analyses

Multivariate analyses were carried out to explore whether there are associations between consumption of the supplements and either dietary or anthropometric changes and whether these associations persist after controlling for potentially confounding factors.

6.7.1. Dietary Data

Multiple regressions were carried out in which the independent variable was energy from the supplement and the dependent variable the residual of change in either dietary or anthropometric variables. Other independent (confounding) variables were socioeconomic levels, morbidity, initial anthropometric status, age, and participation in the government intervention.

The result of these analyses are shown in Table 27 for energy and in Table 28 for protein. Slopes of the relationship between supplement and the residual of dietary changes (these residuals are roughly equivalent to final minus initial dietary values) are given before and after adjustment for potentially confounding factors. Table 27 indicates that save for FFB, supplement intake is associated with changes in total energy intakes and that this association holds after controlling for potentially confounding factors. An unusual feature of Table 27 is that 1 supplement calorie is associated with a change in total energy intake that exceeds 1 calorie in four of the groups: Rice 150, Cookie 150, Cookie 300, and Nutrisoy. Normally, one finds the slopes to be less than 1 and the usual assumption is that the closer the slope is to 1, the less the extent of replacement. The relationship differs markedly in the two rice groups; while the largest slope is for Rice 150 (over 2), the lowest is for Rice 300 (0.7). The cookie groups on the other hand have very similar slopes as would be expected in similar interventions.

Table 28 gives the analyses for protein. Relationships are significant in only three groups: Rice 150, Cookie 300 (but not after adjustment for confoundings factors) and Nutrisoy. Again some of the slopes are larger than expected; 3.4 for Rice 150, 2.9 for Cookie 300 and 1.0 for Nutrisoy.

A different approach is included in Tables 29 and 30. Those consuming less than 50 kcal from the supplement were compared to those consuming more than this amount in terms of their change in total energy intake (Table 29) and in total protein intake (Table 30). This was done before adjustment for confounding factors and after adjustment (by analyses of covariance) for the government food intervention (GFI, intermediate columns) and for GFI and all other potentially confounding factors (next to the last columns). The final column shows the differences between supplemented and poorly supplemented groups; these differences we repeat, have been adjusted statistically for differences between the two groups in the confounding factors already noted. The findings with regards to energy are as follows (Table 29). The groups showing the strongest association are Rice 150 (420 kcal), followed by Nutrisoy (271 kcal), Cookie 300 (248 kcal) and Cookie 150 (117 kcal). Rice 300 gives a negative difference (-21 kcal) between supplemented and poorly supplemented children.

Table 30 shows the findings for protein. Large differences are found for Nutrisoy, Rice 150 and Cookie 300. Readers will note that these three groups were also the ones with the largest slopes in Table 28. For Rice 300, FFB and Cookie 150, the differences between supplemented and poorly supplemented groups are so small relative to the pooled standard deviation of changes in protein (i.e. 20 g) that we can assume there is no relationship in these groups between supplement intake and changes in total protein intake.

Table 27: Relationship between energy from the supplement (independent variable) and the residual of change in energy intake (dependent variable) before and after controlling for potentially confounding factors.[1]

Group	Before[2]		After[2]	
	b_1	t_1	b_2	t_2
FFB (n=36)	0.85	1.46	0.79	1.32
Rice 150 (n=102)	2.14	4.92++	2.05	4.66++
Rice 300 (n=108)	0.68	2.01+	0.81	2.37+
Cookie 150 (n=99)	1.31	2.91++	1.33	2.90++
Cookie 300 (n=68)	1.41	4.37++	1.42	4.22++
Nutrisoy (n=118)	1.34	5.30++	1.32	4.94++

+ $p < .05$
++ $p < .01$

1. Confounding factors: socioeconomic level (two dummy variables), respiratory illnesses (initial and final), diarrheal diseases (initial and final), initial weight, age, government intervention (dummy variable)

2. Units of the slope (b) = kcal of change in intake per kcal of supplement intake.

Table 28: Relationship between protein from the supplement (independent variable) and the residual of change in protein intake (dependent variable) before and after controlling for potentially confounding factors.[1]

Group	Before[2]		After[2]	
	b_1	t	b_2	t
FFB (n=36)	0.55	0.50	-0.26	-0.20
Rice 150 (n=102)	3.39	4.24++	3.39	7.87++
Rice 300 (n=108)	0.68	0.69	1.00	1.00
Cookie 150 (n=99)	1.30	0.72	1.76	0.95
Cookie 300 (n=68)	2.89	2.15	2.90	1.97
Nutrisoy (n=119)	1.03	6.07++	1.02	6.10++

+ $p < .05$
++ $p < .01$

1. Confounding factors: socioeconomic level (two dummy variables), respiratory illnesses (initial and final), diarrheal diseases (initial and final), initial weight, age, government intervention (dummy variable)

2. Units of the slope (b) = g of change in intake per/g of supplement.

Table 29. Total changes in total energy intake by categories of food supplementation (low, high)[1] before and after controlling for potentially confounding factors by analysis of covariance [2].

Group	Before		Controlling for GFI		Controlling for GFI and all covariables		
	High	Low	High	Low	High	Low	Difference
FFB (27,10)	163	-54	164	-55	142	4	138
Rice 150 (66,36)	372	-87	376	-93	358	-62	420
Rice 300 (77,35)	126	193	126	214	147	168	-21
Cookie 150 (39,60)	173	52	161	59	170	53	117
Cookie 300 (38,33)	181	-74	181	-74	178	-70	248
Nutrisoy (35,83)	268	-0	275	-3	270	-1	271
Pooled S.D.			504				

1. High > 50 kcal/day from the supplement
   Low < 50 kcal/day from the supplement
   (,) sample size for high and low respectively

2. First step controlling for the government food intervention (GFI).
   Second step controlling for GFI and for the following covariates: socioeconomic level, initial weight, age final diarrheal index and final respiratory illness index.

Table 30: Changes in total protein intake by categories of food supplementation (low, high)[1] before and after controlling for potentially confounding factors by analysis of covariance.[2]

	Before		Controlling for G.F.I.		Controlling for G.F.I. and all Covariates		
Group	High	Low	High	Low	High	Low	Difference
FFB (27,10)	7.48	3.30	7.57	3.06	6.81	5.12	1.7
Rice 150 (66,36)	5.91	-3.83	5.98	-3.97	5.50	-3.09	8.6
Rice 300 (77,33)	1.65	8.69	1.67	8.65	2.92	5.89	-3.0
Cookie 150 (39,60)	5.31	3.46	5.19	3.54	5.20	3.53	1.7
Cookie 300 (38,33)	3.21	-3.79	3.22	-3.80	3.40	-4.00	7.4
Nutrisoy (35,83)	12.20	2.23	12.42	2.14	12.40	2.15	10.2
Pooled S.D.			20.0				

1 High > 50 kcal/day from the supplement
Low < 50 kcal/day from the supplement
(,) sample size for high and low respectively

2 First step controlling for the government food intervention (GFI)
Second step controlling for GFI and for the following covariates: socioeconomic level, initial weight, age, final diarrheal index and final respiratory illness index.

6.7.2 Anthropometric Data

Similar multivariate analysis were carried out for the anthropometric variables. These data are given in Table 31 for changes in weight for age and in Table 32 for changes in weight for height. There are no significant associations, for any experimental group, either before or after adjustment by confounding factors. Analysis of covariance, of the type described in Tables 29 and 30 for high and low supplemented groups were carried out for anthropometric variables but these results also showed no evidence of a relationship between supplement intake and growth and hence are not presented. No conclusions therefore, can be obtained from analyses at the individual level.

6.7.3 Modeling Diet and Anthropometry

There was an interest in specifying equations predicting changes in diet and anthropometry based upon independent variables. These analyses were carried out but the results are rather discouraging. For example, Table 33 summarizes the patterns. Each column refers to a regression for each of the experimental groups. F values are listed (if they exceeded 1) as a measure of the strength of the relationship and also included is the sign which indicates the direction of the association. All F values greater than 3.8 were statistically significant. The socioeconomic dummy variables tended to be negatively (as expected) related to changes in total energy intakes, at least for FFB, Rice 150, and Rice 300. Energy from the supplement as we have seen, is positively

Table 31. Relationship between calories from the supplement (independent variables) and the residual of change in weight for age (dependent variable) before and after controlling for potentially confounding factors [1,2,3]

Group	Before		After	
	b_1	t	b_2	t
FFB (n=36)	-0.15	0.14	-0.24	-0.20
Rice 150 (n=102)	0.29	0.66	0.03	0.10
Rice 300 (n=108)	0.34	0.88	0.42	1.02
Cookie 150 (n=99)	0.33	0.65	0.62	1.22
Cookie 300 (n=68)	0.54	1.07	0.44	0.88
Nutrisoy (n=119)	0.44	1.40	0.52	1.61

* $p < .05$
** $p < .01$

1. Confounding factors: socioeconomic level (two dummy variables), initial diet, respiratory illnesses (initial and final), diarrhea disease index (initial and final), age, government intervention (dummy variable)

2. Units of slope (b) = % change in weight for age/100 kcal

3. Residuals control for initial nutritional status in weight for age.

Table 32

Relationship between calories from the supplement (independent variable) and residulas of change in weight for height before and after controlling for potentially confounding factors.[1,2,3]

	Before		After	
	B_1	t_1	B_2	t_2
FFB (n=36)	-0.57	-0.32	-0.58	0.28
Rice 150 (n=102)	0.17	0.39	-0.19	0.45
Rice 300 (n=108)	0.43	0.56	-0.18	0.22
Cookie 150 (n=49)	0.08	0.14	-0.06	0.10
Cookie 300 (n=68)	-0.61	1.01	-0.37	0.59
Nutrisoy (n=119)	0.40	1.12	0.38	1.01

1. Confounding factors: socioeconomic level (two dummy variables), respiratory illnesses (initial and final), diarrheal diseases (initial and final), initial weight, age, government intervention (dummy variable)

2. Units of slope (b) = % change in weight for height/100 kcal

3. Residuals control for initial status in weight for height.

Table 33: Values for the relationship between confounding variables and residuals of change in total energy dietary intakes +

Variables +	FFB (n=36)	Rice (n=107)	Rice (n=108)	Cookie (n=99)	Cookie (n=68)	Nutrisoy (n=118)
Supplemental Calories	4.5	26.9	6.0	7.5	20.2	27.9
Socio-economic status level 5	17.6	-4.0	-7.2			1.2
Socio-economic status level 4	12.7	-10.0	-2.5			
Government Food Intervention				4.3	1.1	
Initial weight for age						1.7
Initial Diarrhea		3.0			2.9	1.7
Final Diarrhea						
Initial Respiratory Illness			-2.6		1.2	
Final Respiratory Illness					-3.2	
Age		-1.6				

+ The regression terminated when the F values of the next variable were less than 1. The sign indicates the direction of the association and the F value the strength of the relationship. All F values exceeding 3.8 were statistically significant ($p < .05$).

related to changes in energy intakes and often this relationship is statistically significant. The only other significant F value appearing was the GFI in Cookie 150. The morbidity variables were not strongly related to dietary intakes and the direction of the association was just as likely to the positive as negative.

Results for protein changes and for anthropometric changes were not more promising. In fact, fewer variables than in Table 33 appear to be statistically significant. Hence it was felt that presenting these data in tables should serve no useful purpose.

7.0 Discussion and Conclusions

The aim of this final chapter is to give the reader a sense of the overall findings of the study. The section begins, section 7.1, with an assessment of the strengths and weakness of the study design and the methodology. The next section 7.2, contains an overview and extended discussion of the findings. To aid the reader through this presentation, summary tables of the principal findings are included. Finally, section 7.3 contains the conclusions provided in the summary to facilitate the reader's review in the light of the full study.

7.1 Strengths and Weaknesses

The study has clear strengths and weaknesses. Among the many strengths, units design and methodology are the following:

- Four types of supplements were evaluated (FFB, Cookie, Rice Cereal and Nutrisoy) after extensive ethnographic and market studies.
- Foods targeted to young children (Cookie, Rice Cereal, Nutrisoy) and foods aimed at the entire family (FFB) were tested
- Two levels of supplementary feeding were tested (150 kcal and 300 kcal) for two of the inverventions (Cookie and Rice Cereal).
- Dietary and anthropometric data were used to evaluate the impact of the interventions
- The study subjects were children less than two years of age, a group more vulnerable to malnutrition
- The prevalence of malnourished children in the study sample was greater than in the general population, a feature which increased the chances of detecting a nutritional impact.

These design and measurement characteristics resulted in a complex, diverse study that was able to address a wide variety of questions. At the same time, its very complexity made the study vulnerable to the effects of unforeseen events which interfered with the planned development of the study. Though originally contemplated in the design, a control group was not included because Costa Rican government officials felt it would be unethical to have deserving families not benefiting from any food distribution program. Unfortunately, without a control group, it is more difficult to establish how much of the changes

observed in diet and in growth would have occurred anyway in spite of the interventions. However, comparisons among experimental groups are nonetheless valid assessments of the relative effectiveness of the supplements in altering diets and nutritional status. A second serious difficulty was the unexpected government food intervention, a program of unmeasured characteristics and consequences which affected all study groups and which prolonged the duration of the study, making it harder to supervise. As it turned out, participation in the government food intervention did not seem to alter the possible effects of the supplements nor did it seem to have any substantial effects on dietary intakes or on anthropometry. A probable explanation is that the unsystematic food distribution pattern provided too little food to have a measurable impact. On the other hand, one must also recognize that since the government food intervention was not measured appropriately, (i.e we only know whether a family participated or not during the study in the government food distribution program) its true impact also remains unmeasurable.

The study certainly lasted long enough to make it possible to detect changes in dietary intakes. On the other hand, the duration was perhaps too short to permit detection of changes in height for age.

It was unfortunate that the sampling procedure and the allocation of neighborhoods to treatments resulted in experimental groups so markedly different in sample sizes and in the prevalence of growth retarded ("malnourished") children. The conscious search for malnourished children to increase the potential responsiveness to

the supplements was not the problem, rather the problem was the allocation of malnourished children to the experimental groups was too dissimilar. Thus, the experimental groups differed markedly at the beginning of the study in terms of the prevalence of malnourished children, a feature known to affect the impact of protein-energy supplementation on anthropometry. In order to minimize this problem, analyses were carried by categories of initial nutritional status.

A number of measurement issues also limit the value of the study. The study relied on dietary data collected through the 24-hour recall method. While single 24-hour measurements are appropriate for estimating the mean intake in large samples, single estimates are inadequate for estimating the the mean intake of a small number of individuals or the usual intake of individuals. Dietary intakes before and after the intervention were measured by means of single surveys. Poorer coverage towards the end of the study further reduced sample sizes. The combination of small sample sizes and the large standard deviations typical of dietary intake measures do not allow therefore, for good estimates of means (e.g. 36 cases with dietary information in FFB for the end period of the study). It would have been desirable to obtain three or more dietary measurements during the baseline period and a similar number during the intervention. These multiple dietary assessments, when averaged for the individual would have provided better estimates of the usual intake of individuals and would have reduced the standard deviation.

There were two principal ways of measuring supplement intake: indirectly by measuring the disappearance of stocks and more

to the point, by asking the mother about the amount of foods, including the supplement food, which was consumed by the child. The first measures were collected but not available for detailed analysis at INUAL leaving the food survey data as the primary measure. The problem with this measure is that supplement consumption and total food consumption were measured through the same instrument and at the same moment. Hence, the interdependence of measurement (i.e. the sharing of common errors) is an unknown factor in the analysis relating supplement and home dietary intakes. The data on the independent measures of intake (such as % of stocks remaining) helps to validate the observed supplement/diet associations. But it is not as strong as desirable because only summary data was available to INUAL. Thus, stocks and intake could not be studied with individual level data.

7.2 Overview and Discussion of Findings

The key findings of the study are discussed in roughly the same order in which they were presented in the results. Some of the basic findings of the study are summarized in Table 34 for dietary data and in Table 35 for growth data.

7.2.1. Comparability of Groups

The groups differed in sample sizes, level of malnutrition (see Table 35) and socioeconomic status. FFB and Nutrisoy had the smallest sample sizes (50 and 79 cases respectively, Table 7)

while the others had around 125 cases each. Rice 300 and FFB were the poorest in socioeconomic status and Rice 150 and Nutrisoy were better off. (Table 8). A greater percentage of malnourished children were present at the beginning of the study in FFB; Cookie 300, Rice 150 and Rice 300 were intermediate and Nutrisoy and Cookie 150 were the least malnourished (Table 9). Thus, because, the groups differed in characteristics known to condition the effect of supplement on growth, analyses were carried out which stratified by categories of nutritional status.

7.2.2. Changes in Total Energy Intakes

Dietary intakes also differed markedly at the beginning (see Table 34. The better diets were in Rice 150 and the worst in FFB and Cookie 150. The dietary intakes of all experimental groups increased during the intervention by an average amount of about 120 kcal ($p < .001$). Increases in energy were greater in the rice groups and least in the nutrisoy and cookie groups. However, as there was no clear relationship between initial dietary intakes and the amount of change observed, the difference in initial intake did not appear to substantially effect the study outcome.

Table 34. Basic dietary findings

Group	Sample Size 1/	Energy: Initial Mean Energy Intake (kcal/day)	Energy: Change in Total Energy Intake 2/ (kcal/day)	Energy: Energy Consumed from the Supplements (kcal/day)	Ratio for Energy 3/	Protein 4/: Initial Mean Protein Intake (g/day	Protein 4/: Change in Total Protein Intake 2/ (g/day)	Protein 4/: Protein Consumed from the Supplement (g/day)	Protein 4/: Ratio for Protein 3/	Percent Reporting any Intake of supplement (%)
FFB	37	676	104	106***	1.0	19	6.4	2.5***	2.6	75
Rice 150	102	959	190***	118***	1.6	32	2.5	2.0***	1.3	74
Rice 300	112	843	153**	121***	1.3	29	3.9	2.0***	2.0	77
Cookie 150	99	750	99*	57***	1.7	24	4.2*	0.6	7.0	43
Cookie 300	71	850	62	101***	0.6	28	0.0	1.0	0.0	58
Nutrisoy	118	852	66	58***	1.1	28	5.2**	3.9	1.3	31
All Groups	539	846±504	123±504***	91±113***	1.3	28±18	3.6±21.3***	2.1±4.1***	1.7	--

1. For cases having initial and final dietary information.

2. Final minus initial dietary values.

3. Ratio = change in total diet/supplement intake.

4. Statistically significant group differences ($p<.05$)
   - Changes in total energy intake none
   - Energy consumed from the supplements
     Rice 150 differs from Cookie 150 and Nutrisoy
     Rice 300 differs from Cookie 150 and Nutrisoy
   - Changes in total protein intake - none
   - Protein consumed from the supplements
     Nutrisoy differs from all except FFB;
     Cookie 150 differs from all except Cookie 300.

* Value differs significantly from zero $p<.05$
** Value differs significantly from zero $p<.01$
*** Value differs significantly from zero $p<.001$

Table 35 Basic Anthropometric findings

		Weight for Age (WA) 6/				Weight for Height (WH) 6/			
	Sample Size 1/	Initial WA	Mean WA Changes in the Total Sample	Mean Changes in <80 WA 2/	% Reduction in low WA 3/	Initial WH	Mean WH Changes in the total Sample	Mean Changes in <90 WH 4/	% Reduction in Low WH 5/
FFB	50	79.8	3.6***	6.1***	35	94.5	4.1**	14.5***	54
Rice 150	123	86.6	2.6***	5.2***	23	96.3	3.7***	5.3***	30
Rice 300	125	89.5	1.3***	3.6**	32	100.4	-1.7	5.2**	46
Cookie 150	116	89.6	-0.1	2.1	0	97.3	0.4	3.0	0
Cookie 300	79	85.1	2.5***	3.7**	4	97.1	0.6	6.6***	0
Nutrisoy	147	88.3	0.8	3.1**	7	97.3	1.0	5.5**	32
All Group:	640	87.4 ± 12.0	1.5 ± 5.3***	4.1 ± 5.3***	-	97.5 ± 8.5	1.1 ± 10.7***	6.5 ± 5.5***	-

1. Cases having anthropometry at the beginning of the study.
2. Mean changes for only those cases with initial WA values less than 80%.
3. Fall in prevalence of cases with WA values less than 80%.
4. Mean changes for only those cases with initial WH values less than 90%
5. Fall in prevalence of cases with WH values less than 90%.
6. Statistically significant group differences ($p<.05$)
   - Mean WA changes in the total sample
     Nutrisoy and Cookie 150 differs from the rest; Rice 300 differ from FFB.
   - Mean WA changes in <80 WA
     Cookie 150 differs from all except Nutrisoy; Nutrisoy differs from FFB and Rice 150; Rice 300 differs from FFB and Rice 150; Cookie 300 differs from FFB
   - Mean WH changes in the total sample; FFB differs from Rice 300, and Cookie 150; Rice 150 differs from Rice 300, Cookie 150, Cookie 300 and Nutrisoy
   - Mean changes in <90 WH:
     FFB differs from all other groups

On the other hand, analysis did show that changes were greater for children with higher socioeconomic status (Table 14), better nutritional status (Table 12) and for younger children (Table 13).

The mean increases in total energy intakes were 190 kcal in Rice 150 and 153 kcal in Rice 300 and for all the groups combined the mean was about 120 kcal (Table 34). We find that these mean changes in energy intakes exceed the actual amounts of supplement consumed. Since approximately two months separated the initial and final measures of dietary intakes the mean age at the starting point was 14 months. It is possible that some of the changes in intake would have occurred naturally as the children grew older. If a control group were to have been included, correction for the age factor would have been straightforward. Since such a group was not included, two approaches were followed. First, graphs of energy intake by age were plotted (see Appendix 6) to estimate the level of change over a two month period. This proved disappointing as age and level of intake were not related as expected from other studies A second approach was to measure changes in intake in children consuming less than 50 kcal/day of the supplement (Table 11). It was found that poorly supplemented children changed their intakes by only 17 kcal per day over the two months period. The expected change from other studies would have been around 50 kcal per day. Thus, we cannot know exactly what the correction for the age factor should be but we can say that it probably ranges between 20 to 50 kcal per day. Therefore, we can state that if the mean changes were 120 kcal per day, that between 100 to 80 kcal of this change was produced by the supplements and not by age.

7.2.3. Food Supplement Intake

There was clearly differential consumption of the supplement (Table 34). For energy, the rice groups were highest with nearly 120 kcal/day from the supplements, and Nutrisoy and Cookie 150 the lowest with around 60 kcal/day (Figure 8). The findings differ however when protein is considered (Table 34): Nutrisoy was highest with nearly 4 g per day of protein derived from the supplements, FFB, Rice 150 and Rice 300 were next with 2 g per day from the supplement, and the cookie groups were last with less then 1 g per day. The findings differ when energy is compared to protein because the supplements have very different nutrient compositions. For example, Nutrisoy is rich in protein and hence it is the most effective in raising protein intakes. However, since energy is more likely to be limiting in the Costa Rican diet, most of the analyses emphasized energy and not protein.

Doubling the amount of supplement provided had no impact on consumption of the rice cereal but it did appear to substantially increase consumption of the cookie. One possible explanation is that on the one hand, the mother perceived about 100 calories as the upper limit of what she felt appropriate to feed as supplement or which she found convenient to feed. (More than one feeding may have been required.) On the other, the rice cereal appeared to be less popular with other family members as suggested by quicker disappearance of the total stock distributed to the mother. If this were the case, it might help to explain why the more efficient rice cereal would have reached the 100 calorie saturation point at

the 150 calorie ration level while the cookie only did so at the 300 calorie level. The rice cereal may also have been perceived as more appropriate for the weaning age child, in addition to being less attractive to other family members.

Finally, consumption of the supplement did not appear to depend on nutritional status, age of the child, socioeconomic status, or participation in the government food intervention. These findings are somewhat unexpected as one often finds that "those who need it the most use it the most." It may be that the situation in Costa Rica was difficult for many sectors and that this made the supplement widely attractive to all households.

7.2.4. Consumption

By all measures, the Rice Cereal had higher consumption and Nutrisoy lower consumption than did the other supplements (Table 19). Table 36 shows that Nutrisoy was the least consumed of the supplements while Rice 150 was the best in this regard. Thus, only 18% of the calories given as Nutrisoy were consumed while nearly 80% of those given as Rice 150 were consumed. This finding validates the results of the anthropological and market studies done prior to the intervention which showed that the rice cereal was a most promising food for young children in Costa Rica. Nutrisoy, on the other hand is a food new to the culture and its consumption may require behavioral modifications not demanded by the use of Rice Cereal.

7.2.5. Relationship Between Changes in Total Dietary Intakes and Supplement Consumption

Consumption of 1 kcal from the supplements was associated with a change in energy intake of 2 kcal (i.e. the "slope" of the relationship) for Rice 150, of about 1.3 kcal for Cookie 150, Cookie 300 and Nutrisoy and of less than 1 kcal for FFB and Rice 300 (Table 27). One possibility is that those fed the supplements actually improved their appetites and therefore consumed more of other foods as well. Or, yet another possibility is that the existence of correlated errors in the measurement of home diets and supplement intake result in these very large slopes.

Table 36 Percent consumption of the supplements

	Energy Consumed[1] (kcal/day)	Energy Provided[2] (kcal/day)	$\frac{\text{Consumed}}{\text{Provided}}$ X100
FFB	106	300	35
Rice 150	118	150	79
Rice 300	121	300	40
Cookie 150	57	150	38
Cookie 300	101	300	34
Nutrisoy	58	300	19

1. Amount actually consumed from the supplements
2. In the FFB group, 2000 kcal were provided to the family. It is assumed that 300 of these were for the child.

Consider for example recording errors in the amount of supplement consumed. If the quantity of supplement is erroneously recorded as high, the change (final minus initial diet) will be large as well. If the error causes the quantity of supplement to be lower the change will be small.

7.2.6. Anthropometric Impact

There were statistically significant improvements in weight in almost all experimental groups (Table 35). When the changes are examined as a function of initial status, it is clear that those worst off at the beginning responded the most and vice versa. The lack of a control group, once again, does not permit one to isolate the portion of change that would have occurred as a function of "aging" in the children. One strategy followed to deal with this problem, as explained earlier, was to carry out analyses by categories of nutritional status. In doing so, we found that the prevalence of children with WA values less than 80%, decreased the most in FFB and in the rice groups. Improvements in the prevalence of low weight for height (less than 90% WH) were greatest in FFB, the rice groups and Nutrisoy. For both measures (WA and WH), improvements were less in the cookie groups.

7.2.7. Multivariate Analyses

In the case of the anthropometric data, no significant associations were found with supplement intake. Does this mean there are no such associations? Not necessarily. As explained earlier, single measures of dietary intakes (whether total diet or supplement) are not good estimates of the usual

intake of individuals (the variable one would like to measure). Moreover, another limitation is that the time span of the experiment may have been too short, particularly for variables such as height per age, to demonstrate an effect. Alternatively, the supplement could have altered intakes but not growth. This would have occurred if physical activity was enhanced. As activity was not measured, this must remain an interesting but untestable hypothesis.

The key questions asked about diets in the multivariate analysis were the following: Is supplement consumption significantly related to changes in total dietary intakes? Does this relationship differ across groups? The answer to each question was yes. For energy (Table 27), the relationship was statistically significant for all groups except the FFB. Controlling for potentially confounding factors did not alter the results. Rice 150 produced the largest dietary impact in energy (Table 29) but Rice 300 was one of the weakest in the regard (Table 27 and 29). Rice 150 and Nutrisoy appeared to be the supplements that had the largest impact on changes in protein intakes (Table 28, 30). These associations, as explained earlier, have to be interpreted with caution. The measures of supplement of total diet intake are derived from the same instrument and common errors would tend to give positive correlations.

7.3. Conclusions

The most important findings of the study can be summarized as follows commencing with effect on intake and proceeding to effect on nutritional status itself. First, and the strongest finding, consumption of supplement did vary by type of supplement.

Specifically, the key findings were as follows:

Group	Mean (kcal/day) consumed from the supplements (See Table 34) 1/
FFB	106
Rice 150++	118
Rice 300+++	121
Cookie 150	57
Cookie 300	101
Nutrisoy	58
All Groups	91 ± 113

1/ All values differ significantly from zero ($p<.001$)
++ Value for Rice 150 differs significantly ($p<.05$) from values for Cookie 150 and Nutrisoy
+++ Value for Rice 300 differs significantly ($p<.05$) from those of Cookie 150 and Nutrisoy

As the table indicates, differences between groups in amount of calories consumed were substantial. For example, Rice Cereal at 150 calories is consumed at double the level of calories of Nutrisoy, a supplement containing 300 calories ($p < .05$). Calories conumed from Rice Cereal 150 (as well as Rice 300) were also roughly double the calories consumed from Cookie 150. Both the Rice Cereals and the Cookie at the 300 level also achieve consumption equal to that of the 2,000 calorie Family Food basket. 2/ These findings are also reflected in the percent of children reporting consumption of the supplements and in the percent consumption of energy from the supplement in relation to total amount of supplement distributed.

2/ Intended for all members of the family.

Group	Percent of children reporting consumption (See Table 34)	Percent consumption of energy (See Table 36)
FFB	75	35+
Rice 150	74	79
Rice 300	77	40
Cookie 150	43	38
Cookie 300	58	34
Nutrisoy	31	18

+ Percentage consumption of 300 calories which it is assumed would be child's theoretical share of 2000 calorie Family Food Basket.

With respect to intake of supplement as a function of amount provided, rather than type, the results do not permit conclusions to be drawn. The two cases where different levels of the same supplement were tried did not yield similar results. Thus, in the case of the Cookie, calories of the supplement consumed are roughly double at the 300 level in comparison to the 150 level (101 calories vs. 57 calories). But in the case of Rice Cereal the 150 level and 300 level resulted in approximately the same amount of calories of supplement being consumed (about 120).

One possible explanation for this result is that on the one hand the mother perceived about 100 calories as the upper limit of what she felt appropriate to feed as a supplement or which she found convenient to feed. (More than one feeding may have been required.) On the other, the Rice Cereal appeared to be less popular with other family members as suggested by slower disapearance of the total stock distributed to the mother. If this were the case, it might help to explain why the more "efficient" Rice Cereal would have reached the 100 calorie saturation point at the 150 calorie ration level while the Cookie only did so at the 300 calorie level. The Rice Cereal may also have been perceived not only as being less attractive to other family members but also as more appropriate for the weaning age child .

The study also sought to compare changes in total intake (i.e. home diet plus supplement) between the different groups. The basic findings were as follows:

Group	Changes in total energy intake (See Table 34)
FFB	104
Rice 150	190+++
Rice 300	153++
Cookie 150	99+
Cookie 300	62
Nutrisoy	66
All groups	123 ± 504+++

+p < .05; ++p < .01; +++p < .001

Statistically significant changes in total intake were found for only three groups, Rice 150, Rice 300 and Cookie 150. Dietary intakes increased by 190 and 153 kcal respectively in the Rice 150 and Rice 300 groups while increases in the Cookie 150 were lower, 99 calories. The pattern that emerges is that the Rice Cereal is the supplement both most likely to be consumed by children and most likely to be associated with significant increases in total dietary intakes. However, providing 300 kcal of the Rice Cereal has the same effect as providing 150 kcal of the Rice Cereal.

Proceeding to effect on nutritional status, the most important findings were for changes in the segments of the test groups that were malnourished. Changes in the segment of each group that was nutritionally worst off at the beginning of the study were as follows:

Group	Mean weight for age changes in sample with weight for age less than 80%	% changes in the prevalence of children with weight/age less than 80%	Mean changes in weight for height among children of less than 90%	% changes in the prevalence of malnourished children with weight/height less than 90% 3
FFB	6.1+++	35	14.5+++	54
Rice 150	5.2+++	24	5.3+++	30
Rice 300	3.6++	32	5.2++	46
Cookie 150	2.1	0	3.0	0
Cookie 300	3.7++	4	6.6+++	0
Nutrisoy	3.1++	7	5.5++	32
All groups	4.1 ± 5.3+++		6.5±5.5+++	

3/ Data in this table taken from Table 35

++p < .01; +++p < .001

The results indicate some differences by type of supplement. In particular Rice 150 stands out as much better than Cookie 150 and equal to, and by some measures better than, the larger supplements (Cookie 300 and Nutrisoy). Also although Rice 300 does not show improvement relative to Rice 150, the Rice Cereals appear strong by many of the measures in relation to the Cookie groups. The table also provides an interesting comparison with the Family Food Basket. Thus the targeted supplements, in particular Rice 150, do relatively well in comparison to the 2000 calorie Family Food Basket. The latter provides half of its calories as oil.

The persuasiveness of the findings is limited by a number of factors. First, there was no control group to estimate the level of change that would have occurred naturally without the interventions. Some of the changes in dietary intakes, for example, may be due to the fact that children became older during the course of the study. Some of the changes in growth may have also been a function of age. Thus, not all changes that occurred can be entirely attributed to the interventions. However, comparison between groups are valid because all groups were followed simultaneously.

A second problem is that the groups were not entirely homogeneous with respect to factors which condition dietary and growth response to supplementation. Thus, the group receiving the Family Food Basket had the poorest measures of growth and the worst diets at the beginning of the study. The group receiving Nutrisoy, on the other hand, showed the best dietary and anthropometric characteristics at the beginning of the study. One strategy for dealing with problems of noncomparability is to stratify by the variable in question. Thus, analyses were carried out which examined dietary changes by various categories of age, socioeconomic status and initial diet. These analyses did not suggest a different interpretation than that provided by analyses which were not stratified. So that lack of homogeneity did not appear to materially influence the associations observed between type of supplement and total intake. Similar analyses were done for anthropometric changes. In this case also initial diet and nutritional status did not appear to materially influence the pattern of difference between the groups receiving different supplements.

Finally, while in some cases groups that with the higher consumption of supplement had the higher growth, an association between dietary measures and growth could not be confirmed in more detailed analysis at the individual level. This may have been due to the fact that the dietary measures available in this study are single 24-hour recall measures. Measuring intake once rather than taking an average of several measures can result in a very large variation.

In conclusion, in answer to the question whether there is a relationship between type and amount of supplement and effect on nutritional status in a take-home feeding program, the study indicates the following for the Costa Rica case. First, the strongest finding was that a clear relationship existed between type of supplement and intake of supplement. Second, the study does not permit conclusions to be drawn regarding the effect on intake of amount of supplement as the findings for the two supplements studied in this manner (Cookie and Rice Cereal) are contradictory. Third, statistically significant results for total intake were found for some of the groups, Rice 150, Rice 300, and Cookie 150, and these findings generally supported the pattern found for differences in intake of supplement. Finally, weight for age changes suggest that the nutritional status varied as a function of the type of supplement provided, though it was not possible to show a significant association between measures of intake and changes in nutritional status.

In overall terms the fairly consistent high performance of Rice 150 suggest that an efficient supplement has the potential to make a substantial difference in a take-home program. Further, it is significant that selection of this supplement was based on prior identification of properties likely to result in its perception as particularly appropriate for young children. It is also interesting to note that despite the potential problem of intra-family dilution, a relatively small supplement (150 calories) had similar consumption to that of a family ration that provided the equivalent of about 300-400 calories per family member.

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APPENDIX. 1

PROFILE OF A FOOD FOR CHILDREN LESS THAN 2 YEARS IN AGE

(summary)

CITA, July 1982

This research seeks to identify the ideal characteristics of a cookie designed to be consumed by children under two years. A semiestructured questionnaire was used and data were collected for 984 mothers who had children under two years of age.

Table A1.1. presents mother's opinions about special foods for children under two years of age. The results were: 99% of mothers identified fruits; 95% milk, 80% cookies, 66% vegetables, 40% egg and 20% others products.

Table A1.2. shows the colors mothers prefer for children under two years of age. 60% of mothers prefer red, 58% yellow, 40% sky-blue and 35% prefer white.

Table A1.3. shows the responses to the question: which figures are more appropriate for children's games. The answers were that 90% of mothers prefer animals, 20%, birds and 5% did not answer.

Table A1.4. presents data about mother's preference about food flavors for foods for children under two years of age. The answers were that 80% of mothers said foods should be salty and sweet, 8% sweet and 10%, salty.

Table A1.5. provides data on how mothers perceive the effectiveness of modern medicine to be and on the extent to which mothers follow instructions regarding the use of medicines. It was found that 54% of the mothers think that medicines always heal illness; 40% believe they sometimes do, and 5% think medicines never work. At the same time, Table A1.5

shows that 80% of the mothers always follow medical instructions, that 15% do so sometimes and that 1% never do.

These results allow one to identify some of the ideal characteristics a cookie designed for children should have.

Table A1.1 - Special foods for children under two years

Type	Percentage
Fruits	98.7
Milk	94.9
Cookies	78.5
Vegetables	65.9
Eggs	40.1
Marshmallows	10.5
Others	19.5

Table A1.2 - Colors for children under two years

Color	Percentage
Red	61.2
Yellow	57.8
Sky-blue	47.6
White	35.2

Table A1.3 - Appropriate figures for children under two years of age.

Type	Percentage
Animals	88.6
Birds	22.2
Others	99.7
Non responses	4.9

Table A1.4 - Appropriate food flavors for children under two years of age.

Type	Percentage
Sweet	8.1
Salty	10.9
Both	81.0

Table A1.5 Regard for the effectiveness of medicines and completion of medical instructions

Effectiveness	100.0
They always heal the child	54.8
Sometimes	38.4
Never	5.3
Non responses	1.5
Medical instructions	100.0
Mother always follow them	82.5
Sometimes	14.4
Never	1.2
Non responses	1.9

APPENDIX 2

COOKIE ACCEPTABILITY IN CHILDREN LESS THAN 2 YEARS IN AGE

CITA, 1982

Four types of cookies differing in size, shape and hardness, were tried. Acceptability was measured via direct observation and mother's opinions. The four cookies were:

Cookie 1, "Maria Dorada" is commercially produced. It enjoys high market prestige. It is round thin and soft.

Cookie 2, "Popular", is also available commercially at a low price. It is round and sweet and it is thicker and harder than Maria Dorada.

Cookie 3, "Lengua de Gato" is sweet, long-and-narrow shaped, thin and soft.

Cookie 4, "Polka" is sweet and long-shaped, very thick and the hardest of all four cookies.

The following tables present the result of the acceptability trials.

Table A2.1

Is the cookie easily held by children?

Cookie	Yes n	Yes %	No n	No %
1	34	75		
2	7	100	-	-
3	15	82	3	16
4	1	50	1	50

Table A2.2

Is the cookie size adequate for children?

Cookie	Yes n	Yes %	No is very big n	No is very big %
1	30	66	15	3
2	7	100	-	-
3	14	100	-	-
4	1	50	1	50

Table A2.3

Does the child have problems eating the cookie?

Cookie	Yes n	Yes %	No n	No %
1	3	6	42	93
2	-		7	100
3	-		17	100
4	1	50	1	50

Table A2.4

What kind of problem does the child have?

Cookie	1		4	
	n	%	n	%
It hurts the child's mouth	1	33	-	-
Cough	1	33	-	-
The child doesn't hold it	1	33	-	-
The child eats the cookie only with milk	-		1	100

Table A2.5

Does the mother consider the cookie to be nutritive?

Cookie	Yes		No	
	n	%	n	%
1	40	88	5	11
2	6	85	1	14
3	13	76	4	24
4	2	100	-	-

Table A2.6

Does the mother give cookies to her child?

	n	%
Yes	61	86
No	10	14

Table A2.7

According to the mother, does the child like the cookie?

Cookie	Yes n	Yes %	No n	No %	she doesn't know n	she doesn't know %
1	44	97	-	-	1	3
2	7	100	-	-	-	-
3	16	18	-	-	2	11
4	1	50	1	50	-	-

Table A2.8

According to the mother, how old was the child when he or she was first given cookies?

Age (months)	n	%
1-2	9	35
3-4	11	42
5-6	4	15
7-8	2	8

Table A2.9

Difficulties the child has with the cookie (percentage)

Cookie	1	2	3	4
He can't hold it	6	-	11	-
He can't swallow it	6	-	-	-
It is easy to break	6	-	23	-
He only moist the cookie	18	-	-	-
It is hard	-	25	29	100
He doesn't eat all thr cookies	15	50	17	-
He only eats the cookie with milk	6	-	5	-

APPENDIX 3

MARCEL GRAFFAR SOCIOECONOMIC SCALE

The Marcel Graffar socioeconomic scale was developed in 1952, by the Child International Center, in Paris. It has been used in several nutritional surveys (France, Belgium, England, Switzerland, Sweden, Uganda and USA). In the last decade, it has had wide diffusion in Peru, Colombia, Chile, Argentina, Brazil and Mexico.

The Graffar index has five subindexes; each subindex can have a value of 1 (best) to 5 (worst) points. The five subindices are type of house, type of neighborhood, family income source, education of the head of household and activity of the head of household. The total points (5 to 25) are then coded into 5 categories (e.g. 25-21 is category 5, 20-16 is category 4, etc.) In Chile, the scale has been used in the ENANOS survey in 1975; in that opportunity, 1104 children were surveyed, and it was found that the Graffar scale was significantly associated with malnutrition. INUAL also found in 1977 that the prevalence of malnutrition varied significantly by categories of the Graffar scale in a sample of 1863 children under six years of age. A brief description of the variables and the categories of Graffar scale is given below.

Householder's Activity

-Category 1: high prestige, high power and high income
 -Top executives, top civil and business leaders
-Category 2: high prestige job, or power and medium to high incomes
-Professionals, small business owners and excutives

Category 3: medium prestige, medium incomes, low power
Administrators, supervisors, specialized people without a university career, retailers.

Category 4: low prestige job, income and power
Non specialized workers, drivers

Category 5: low prestige, power and income job, without stable activity

Family income source

Category 1: the main income source is the inherited or acquired fortune

Category 2: income consist of profits (traders) and fees (professionals)

Category 3: the income is a monthly salary

Category 4: the income is a weekly salary

Category 5: the family lives on public or private charity

Quality of housing

Category 1: luxury house or apartment

Category 2: comfortable and spacious houses or apartments

Category 3: houses or apartments with solid materials and well maintained. No more than 2 persons per bed, no more than 4 persons per room.

Category 4: id. 3 with more than 2 persons pe bed and more than 4 persons per room.

Category 5: wooden house without portable water. No ventilation, nor bathroom. Lack of comfort.

APPENDIX 4. Data forms used in the study: Anthropometry, Socioeconomic Status, Morbidity and Dietary Survey

ANTROPOMETRIA DEL NIÑO

	Identific.	Sexo	FECHA Día	FECHA Mes	Peso en gramos	Longitud	EDAD Meses	EDAD Días	REPETICION Repet.	REPETICION Hora
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

INSTRUCTIVO

Cuadro 1 de identificación: Localidad:

1. _____
2. _____
3. _____
4. _____
5. _____

Sexo: 1 Hombre
2 Mujer

PROYECTO 0-2 AÑOS
INUAL-CITA

. DATOS ANTROPOMETRICOS

1.	Identificación	Loc. Nº niño
2.	Fecha Nacimiento	Día Mes Año 8 2
3.	Peso Nacimiento (en gramos)	
4.	Sexo 1 : Hombre 2 : Mujer	
5.	Fecha Control Nº1	8 2
6.	Peso Control Nº1 (en Kgr con un decimal)	
7.	Talla Control Nº1 (en cms con un decimal)	
8.	Fecha Control Nº2	8 2
9.	Peso Control Nº2	
10.	Talla Control Nº2	
11.	Fecha Control Nº3	8 2
12.	Peso Control Nº3	
13.	Talla Control Nº3	
14.	Fecha Control Nº4	8 2
15.	Peso Control Nº4	
16.	Talla Control Nº4	
17.	Fecha Control Nº5	8 2
18.	Peso Control Nº5	
19.	Talla Control Nº5	

CUESTIONARIO SOCIOECONOMICO

1. Identificación

2. Fecha

3. Tipo de actividad del jefe de hogar

   1 Ocupación de alto prestigio, poder e ingreso económico (banqueros, gerente de grandes firmas comerciales, ministros, etc)

   2 Ocupaciones de alto prestigio, poder e ingreso medio alto (profesionales con título universitario, propietarios, administradores ejecutivos, etc).

   3 Ocupaciones de prestigio e ingreso medio, poder bajo (administradores, empleados públicos y particulares, obreros especializados, etc.)

   4 Ocupaciones de bajo prestigio, poder e ingreso (obreros sin especialización, cuidadores, vendedores ambulantes, etc)

   5 Ocupaciones u oficios con actividad inestable (mensajeros, porteros, aseadores a domicilio, etc).

4. Fuente del ingreso principal familiar

   1 La fuente de ingreso es la fortuna heredada o adquirida

   2 Los ingresos consisten en provechos, ganancias y honorarios

   3 El ingreso es un sueldo, es decir, una remuneración calculada sobre una base anual o mensual y pagada mensualmente.

   4 El ingreso consiste en un salario, es decir, una remuneración calculada a la semana, al día, a la hora, a la pieza, o a la tarea.

   5 La familia vive de socorros de origen público o privado

5. Tipo de vivienda

   1 Casas o departamentos de lujo

   2 Casas o departamentos confortables y espaciosos

   3 Casas o departamentos modestos, de construcción sólida

   4 Construcciones sólidas con hacinamiento y/o promiscuidad, o mal conservadas o casas prefabricadas

   5 Mejoras y pocilgas

6. Tipo de Barrio

1 Barrio residencial elegante

2 Barrio residencial de casas confortables

3 Calles de comercio y antiguas

4 Barrio obrero

5 Barrio de pocilgas y mejoras

7. Educación del jefe de hogar

1 Instrucción universitaria o equivalente

2 Instrucción secundaria completa o técnica superior

3 Instrucción secundaria incompleta

4 Instrucción primaria completa

5 Instrucción primaria incompleta y analfabetos

8. Educación de la madre

1 Instrucción universitaria o equivalente

2 Instrucción secundaria completa o técnica superior

3 Instrucción secundaria incompleta

4 Instrucción primaria completa

5 Instrucción primaria incompleta y analfabetas

CENTRO DE INVESTIGACIONES EN TECNOLOGIA DE ALIMENTOS (C.I.T.A.)
UNIVERSIDAD DE COSTA RICA

ALIMENTOS PARA NIÑOS MENORES DE 2 AÑOS

REGISTRO DE ENFERMEDADES DEL NIÑO

Tarjeta Nº 2

IDENTIFICACION: _____ [| | |] 1 2 3 4

FECHA _____ [| | | | |] 5 6 7 8 9 10

DIRECCION: _____

_____

ENCUESTADOR _____ [|] 11 12

1- Si tuvo calentura, cuántos días le duró ?

00 : no tuvo
99 : no sabe, no responde

[|] 13 14

2- Si estuvo inapetente, cuántos días estuvo comiendo menos que antes o casi nada ?

00 : no tuvo inapetencia
99 : no sabe, no responde

[|] 15 16

3- Si tuvo angina (glándulas inflamadas), cuántos días le duró ?

00 : no tuvo
99 : NS/NR

[|] 17 18

4- Si estuvo con tos, cuántos días le duró ?

[|] 19 20

5- Si tuvo diarrea, caca suave, mal de estómago o gastro, cuántos días le duró ?

[|] 21 22

6- Si tuvo diarrea, qué número de veces obró el día que tuvo mayor número de deposiciones (en 24 horas)

0- Entre 0 y 2
1- Entre 3 y 5
2- 6 - 10
3- 11 y más

[ ] 23

7- Si tuvo bronquitis, tos, nariz trancada, otitis (dolor de oído o supuración), gripe o resfrío, cuántos días le duró ?

00 : no tuvo
99 : NS/NR

[|] 24 25

8- Si tuvo otra enfermedad infecciosa, cuántos días le duró ?

[|] 26 27

9- Repetición

[|] 28 29

[illegible]/13-9-77

PROYECTO 0-2 AÑOS

RECORDATORIO ALIMENTACION DEL NIÑO

Identificación

Fecha

Repetición

Encuestador

	CANTIDAD CASERA	ALIMENTOS	CANTIDAD MEDIDA
DESAYUNO (Y ANTES)			
ENTRE COMIDAS			
ALMUERZO			
ENTRE COMIDAS			
COMIDA			
DESPUES DE COMIDA			

R E C E T A S

COMIDA	CANTIDAD CASERA	INGREDIENTES

1) Desde el desayuno de ayer hasta el desayuno de hoy, ¿ el niño tuvo: inapetencia, calentura, diarrea o vómitos ?

1. SI
2. NO ☐

2) Recibe ayuda ? ☐☐

00 No aplica
01 Va a almorzar al CDI todos los días
02 CDI algunos días en la semana
03 Leche en polvo
04 Leche con cereal
05 Programa ALIN (con aceite)
06 Programa DAF (canasta sin aceite, con manteca)
07 Dinero
08 Combinaciones
Aclare: _____
09 Otro
Aclare: _____
99 NS/NR

APPENDIX 5

HEALTH INDEX

BY FACTOR ANALYSIS

(Prepared by INUAL)

The appendix presents the results of a factor analysis of 7 variables often considered in the assessment of the child's health status. The purpose is to determine the minimum number of independent parameters necessary to gain the most of the information provided by the 7 measures. The independent parameters were selected by factor analysis, an application of matrix algebra, in which the eigenvalues of a matrix are used to group the variables that exhibit the same pattern of relationships.

The factor analysis, using the SPSS package, was applied to the following variables: duration of fever, lack of appetite, cough, angina, diarrhea, bronchitis and the severity of diarrhea. The results were very satisfactory. With only two factors, one can account for 88% for the health status variance, each factor can be thought of as a group of observations that correlate highly with one another and lowly with the rest.

The most important variables were the duration of diarrhea, cough, bronchitis and the severity of diarrhea. Furthermore, the first factor included the duration of diarrhea and its severity and the second, cough and bronchitis.

The loadings for these variables for each factor, represent the correlation between the real measures and the theoretical measures. The higher the correlation, the higher is the loading of the variable.

The indexes obtained were as follows:

1_{diarrhea} = .54 diarrhea duration + .44 severity of the diarrhea

$1_{\text{bronchitis}}$ = .43 cough duration + .48 bronchitis duration

APPENDIX 6

INTAKE, WEIGHT AND HEIGHT AS FUNCTION OF AGE

A series of graphs are presented below. Dietary and anthropometric data collected at the beginning of the intervention (i.e. prior to the distribution of the supplements) are plotted on age. The idea was to explore how age might be related to these key variables in the population under study. The study population had an average age of 14 months at the beginning of the study. The food intervention lasted 3 months.

A6.1. Dietary Variables

The data for energy is given in Figure A6.1. and for protein in Figure A6.2. There were few cases less than 12 months of age. Unlike what is generally observed in other studies, a rising trend with age is not apparent in these data.

A6.2. Anthropometry

The anthropometric data are given in Figures A.6.3. for height for age, A6.4 for weight for height and A6.5 for weight per age. Data from the control group (no food intervention) of the Colombian study by Mora et al (5) are included for comparison. The data for children less than one year are peculiar. One should recall that the Costa Rican sample was not a natural population but rather that efforts were made to identify as many poorly malnourished children as possible. The Costa

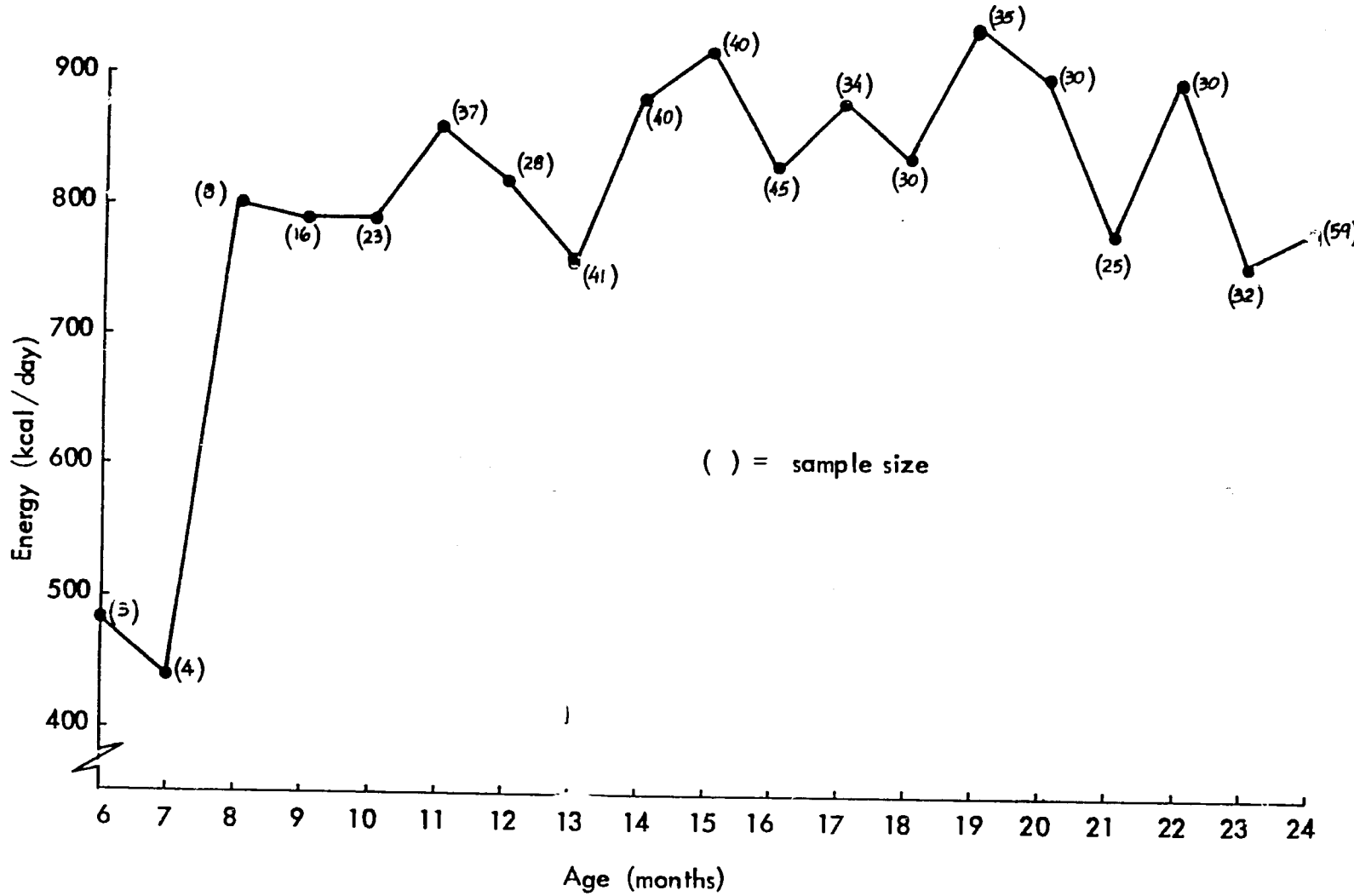

Figure 41: Energy by age, Costa Rica

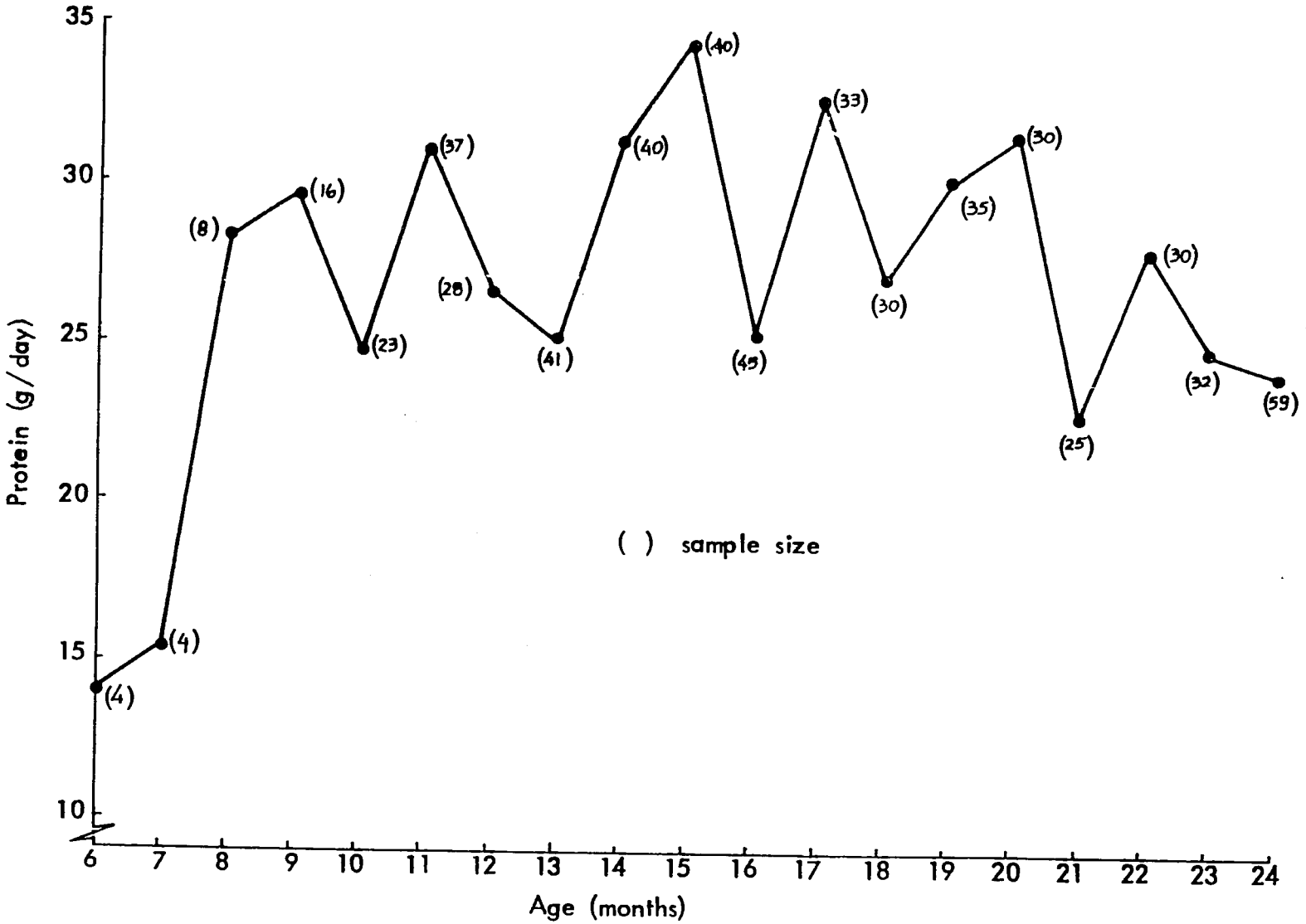

Figure 6.2: Protein by age, Costa Rica

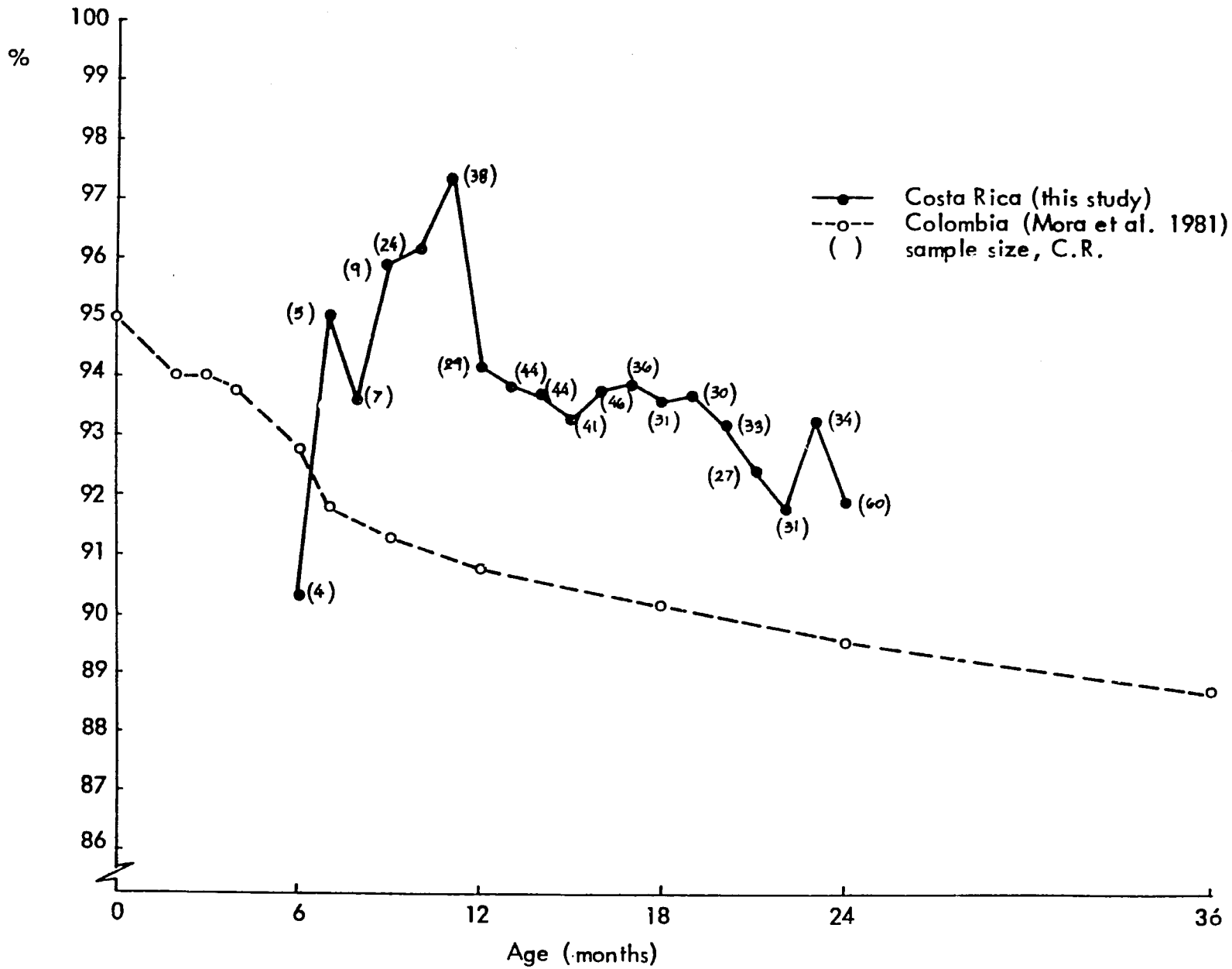

Figure A6.3 : Height for age (%) by age

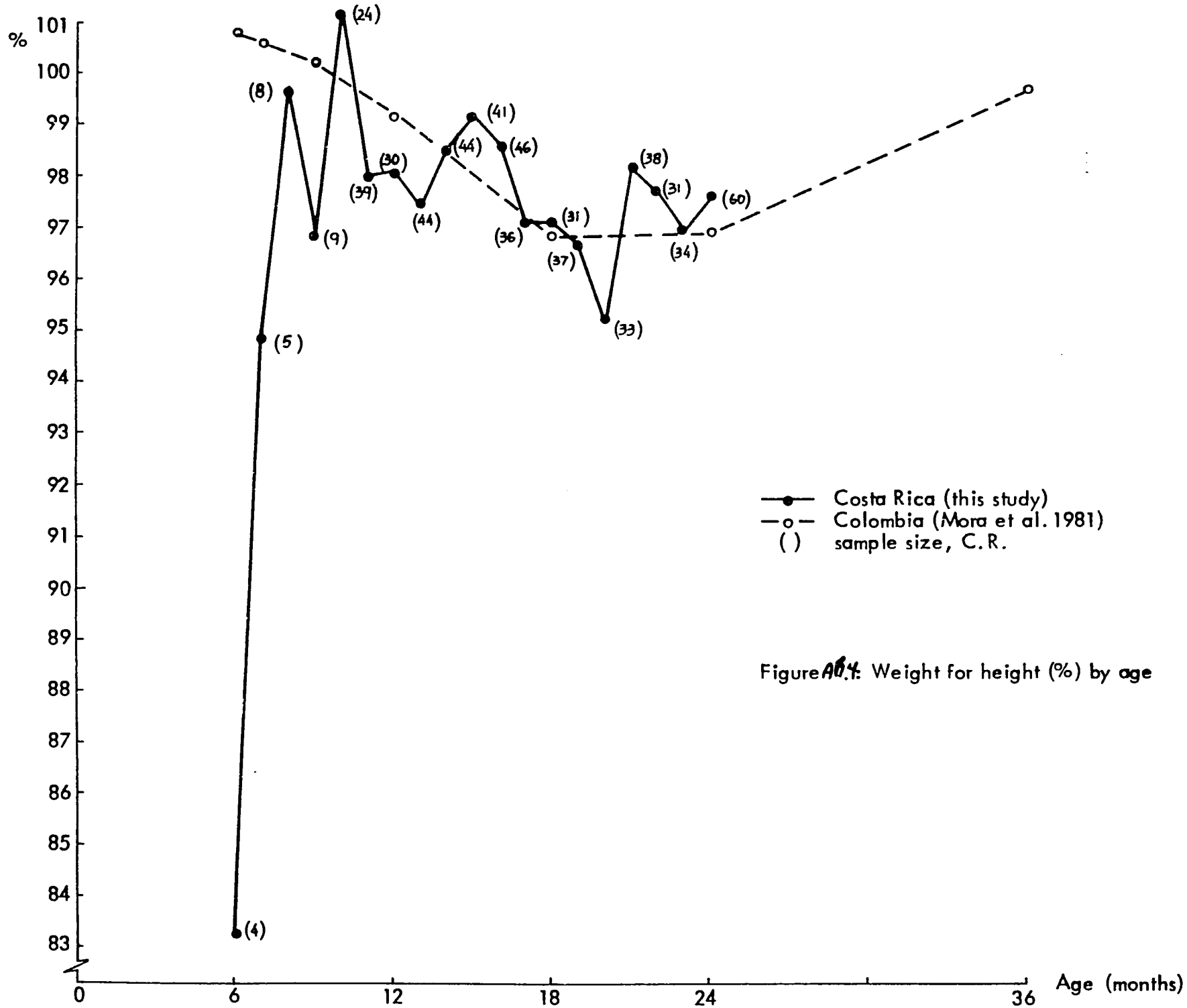

Figure A0.4: Weight for height (%) by age

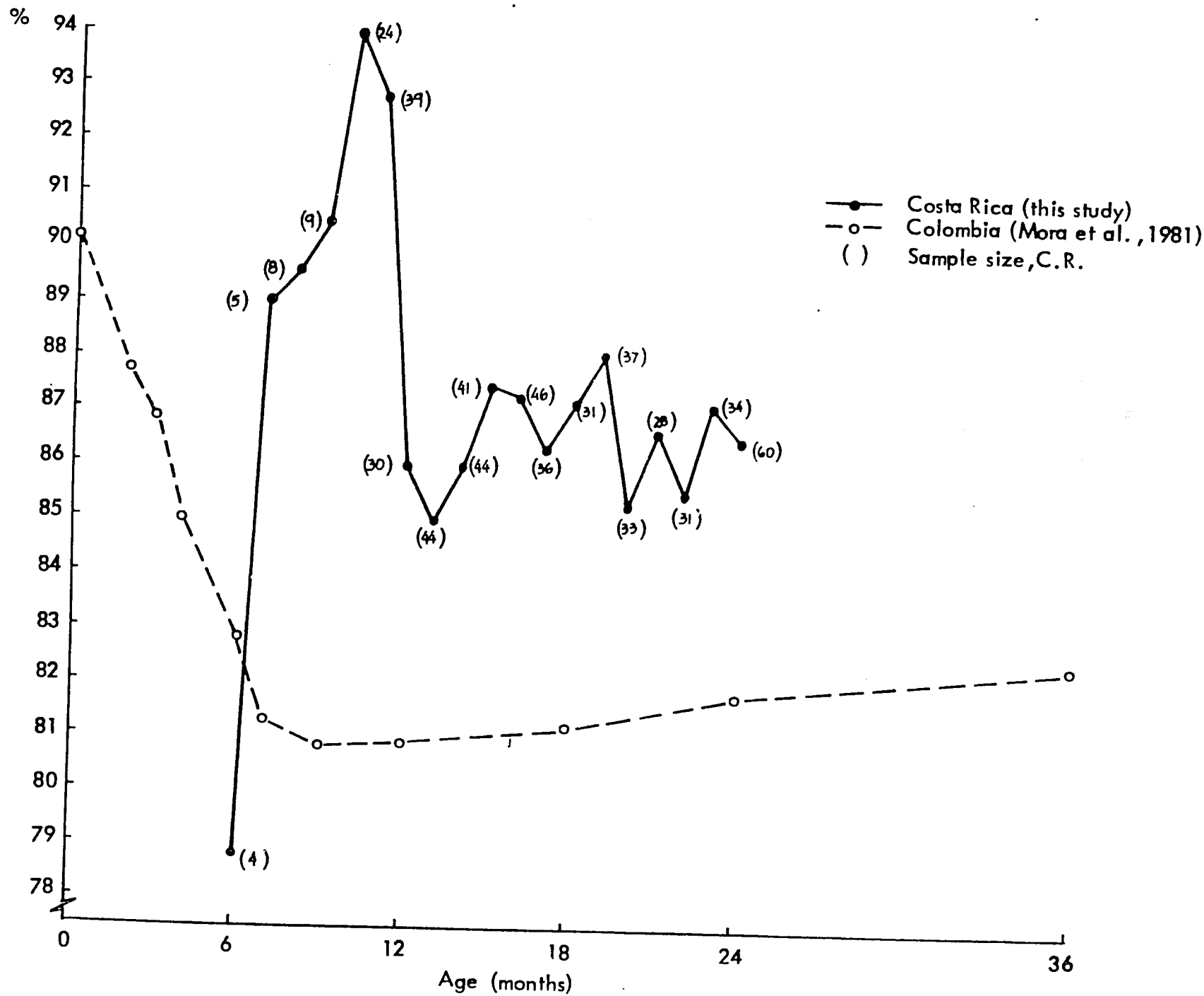

Figure A0.5 : Weight for age (%) by age

Rican children follow the same general trend evident in the Colombian data. Shifting the age of the population from 14 to 17 months would seem to lead to

a) a decrease in % height for age

b) an improvement in % weight for height

c) a minor improvement in weight for age.

The important point to keep in mind is that children do change in dietary and anthropometric characteristics as they age.