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ENERGY SUPPLEMENTATION AND FOOD CONSUMPTION IN A MALNOURISHED POPULATION OF RURAL GUATEMALA

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ABSTRACT

An experiment was designed to evaluate the dietary impact of a high-energy supplement. Daily, for four weeks, two "cookies" containing 250 calories and 4 g of protein were provided to every family member in a small Guatemalan village. Four 24-hour recall surveys were collected per study subject prior to the intervention and, similarly, during the intervention. Energy intakes improved as expected: 173 cal in men ($p > 0.5$), 201 cal in women ($p < .01$), and 178 cal in children less than 5 years of age ($p < .01$). The energy supplement did not modify protein intakes ($p > .05$) nor did it alter the consumption of specific foods.

INTRODUCTION

The consensus among nutritionists is that the principal dietary problem in Central America and in most other parts of the Third World is that intakes are low in energy, rather than in protein as formerly believed (1-3). Similarly, most governments realize that such dietary deficits and the resulting malnutrition are manifestations of poverty and that their ultimate erradication is dependent upon improvements in socioeconomic conditions. Nonetheless, as a short-term strategy, perhaps while more profound changes are made, many governments are planning or have already implemented food supplementation programs for the poor.

Though many food supplementation programs have been carried out to date, information regarding their impact on the nutritional status of target individuals is available only in a few instances (4-9). Even less is known about the effects of the supplements on the usual diet (4, 8, 9, 11, 12).

The distribution of free foods is often found to reduce the consumption of regular food items in the target individuals and in other family members, especially in situations where supplies are distributed to be consumed at home (4, 8, 9, 11-13). Depending upon the magnitude of these effects, the resulting changes in nutrient intake may be too small to have a measurable effect on the nutritional status of the target population, as may have been the case in some studies (4).

As greater emphasis is now given to programs aimed at improving energy intakes in Central American countries, a study was carried out in rural Guatemala to measure the short-term dietary impact of a high-energy supple-

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mentation program. This paper describes, for men, women, and children, the effects of the program on the consumption of specific foods and estimates the actual amount by which energy as well as protein intakes changed.

MATERIALS AND METHODS

The study took place in a small community located in the mountainous slopes of the Pacific Coast of Guatemala. The population, approximately 350, was predominantly Indian in ethnic and cultural background. A cross-sectional evaluation of nutritional status showed that 40% of the children under five had second and third degree malnutrition (14).

An attempt was made to improve energy intakes through the distribution of a high-energy cookie made from a mixture of corn (40%) and wheat flour (60%), sugar, and vegetable fat. Each cookie, 33 g in weight, provided 125 calories and a small amount of protein, 2.0 g.

The dietary intakes of selected family members (fathers, mothers, and children less than five years of age) were assessed once a week for four weeks prior to the distribution of the supplement. The surveys were timed to sample variability associated with days of the week. The dietary assessment was done through a modified 24-hour recall method which gives special emphasis to the weighing of family-specific household measurements and amounts. The correlation coefficients between intake values (energy as well as protein) obtained by this method and values obtained for the same 24-hour period by a methodology combining the record and direct weighing techniques were around 0.75 ($p < .05$) in two samples (22 mothers and 25 children). Moreover, no significant differences were found between the mean energy or protein intakes obtained by the two methods.

Daily, during the four weeks, each family took home two cookies per family member, an amount equivalent to 250 calories and 4.0 g of protein per individual. Dietary surveys were carried out once a week for the four weeks of the supplementation program as in the baseline period.

The analyses of the information focused on the comparison of food and nutrient intake before and during the food supplementation program. The comparisons were limited to protein and energy intake and to those few foods which provided most of these two nutrients in the study population. Values compared, it should be stressed, always represent the mean of four dietary surveys. Single dietary surveys do not, even if perfectly conducted, tap enough of the variability in usual intake. Diets in rural communities may be monotonous in terms of the number but not in the amount of food consumed.

RESULTS

The mean energy and protein intakes, prior and during the daily distribution of cookies, are presented in Table 1. All age groups under study experienced, as a result of the distribution of cookies, an important increase in energy intake. A net daily increase of 173 calories was observed in men, 201 calories in women, and 178 calories in children less than five years of age. The increase in energy intake was statistically significant for women ($p < .01$), for children 24 to 47 months ($p < 0.01$), and 48 to 60 months in age ($p < 0.05$).

Protein intake appears to have decreased by 1.4 g in men, 1.3 g in women, and 3.5 g in children 48 to 60 months in age. On the other hand, increases of 1.0 g and 3.5 g were observed in children 24 to 47 and 48 to 60 months in age respectively. None of the changes in protein intake were

Table 1.--Impact of the intervention on energy and protein intake

Groups	n	Calories (kcal/day)				Protein (g/day)			
		X_1	X_2	Δ_1	S	X_1	X_2	Δ_1	S
Adults									
Men	31	3189	3362	173	560	98.8	97.4	-1.4	16.5
Women	39	2369	2570	201**	414	73.2	71.9	-1.3	13.7
Children									
23 months or less	11	599	739	140	233	16.2	17.2	1.0	7.4
24 to 47 months	15	912	1153	241**	250	27.1	30.5	3.4	7.4
48 to 60 months	11	1136	1269	133*	188	35.3	31.8	-3.5	6.3
All children	37	886	1064	178**	225	26.3	26.9	0.6	7.1

n Sample size
X_1 Mean before the intervention
X_2 Mean during the intervention
Δ_1 Change associated with the intervention (X_2-X_1)
S Standard deviation of change in intake
* $p < .05$
** $p < .01$

statistically significant ($p > 0.05$).

Table 2 shows the impact of the intervention on the consumption of specific foods in men and women. Table 3 provides similar information for children. The only significant change recorded in all groups was in cookie consumption. Out of the other 50 possible comparisons in Table 2 and 3, only one, consumption of milk products in children 24 to 47 months of age, was statistically significant ($p < 0.05$). Negative tendencies (i.e., evident in at least four of the groups) were observed for eggs, beans, corn and wheat products. Positive tendencies were evident for refined and unrefined sugar.

Estimates of the overall impact of the cookie intervention on the energy and the protein amounts provided by the usual foods are shown in Table 4. Net change (Δ_1) refers to the changes in total nutrient intake already shown in Table 1. By multiplying the amount of cookie consumed by each group (Tables 2 and 3) by the energy and protein content of the cookie, the contribution of the cookie (Δ_2) can be obtained. The difference between these two values ($\Delta_2-\Delta_1$) indicates the extent by which the energy and the protein provided by the "usual" diet was modified. In general, the cookie appears to have reduced "usual" food consumption. In the case of energy, the decrements ($\Delta_2-\Delta_1$) represent 2% to 3% of the usual intake (X_1, Table 1) in men, women, and children under 24 months. In children 24 to 47 months the decrease in "usual" energy intake was more pronounced, 12%. The decrements in usual energy intake were, as shown in Table 4, more than compensated by the energy provided by the cookie. The protein changes in the "usual" diet were small enough to have been made up by the small protein content of the cookie.

DISCUSSION

The energy intakes found in this study for men and women are somewhat higher than those usually recorded in the area (i.e., 2800 calories for men and 1900 calories for women). This may be due to the fact that the study took place during the coffee harvest, a period that demands more energy expenditure but which also provides families with additional income. Thus, it is possible that different results would have been obtained if the study had been carried out at other times of the year when intakes are generally lower.

Interestingly, the consumption of cookies in adults and in children approximated two cookies per individual as originally planned suggesting that the distribution of the supplements between family members was equitable. The intervention produced an increase of nearly 200 calories per day in adults and in children but did not modify net protein intakes. The "usual" energy intakes decreased slightly and as a result only 8 out of 10 calories provided by the cookie were truly a supplement (i.e., replacement level of 20%). While no significant food shifts were identified, tendencies were noted towards a decrease in egg and grain consumption and an increase in sugar intake.

There is a general lack of information regarding replacement levels in supplement programs which use feeding centers (4, 5, 10). In a study carried out in India, children were offered a high energy sweet cake, much like the cookie of the present study in nutrient composition. Based upon a comparison of a single 24-hour recall survey carried out on a subsample of children before and during the program, the authors reported that there

Table 2.--Impact of the intervention on food consumption in adults (g/day)

Foods	Men (n=31)				Women (n=39)			
	X_1	X_2	Δ	S	X_1	X_2	Δ	S
Milk	73.7	81.6	7.9	156	58.3	52.8	-5.3	101
Eggs	31.0	26.5	-4.4	22	19.9	18.2	-1.7	14
Meat	68.7	69.0	0.3	64	54.4	46.7	-7.8	44
Beans	42.1	35.3	-6.8	40	32.7	26.8	-6.0	33
Corn	629.8	604.3	-25.5	139	447.3	439.2	-8.1	117
Wheat products	21.5	14.2	-7.3	24	20.1	11.8	-8.3	27
Rice	29.0	27.5	-1.5	37	16.4	21.6	5.2	26
Refined sugar	61.1	72.3	11.2	34	46.2	55.0	8.8	26
Unrefined sugar	36.8	40.5	3.7	21	38.2	41.0	2.8	24
Fats	6.7	5.9	-0.8	9	4.5	5.6	1.0	6
Cookie	0.0	67.3	67.3**	20	0.0	63.1	63.1**	19

X_1 Consumption before the intervention

X_2 Consumption during the intervention

Δ Change associated with the intervention (X_2-X_1)

S Standard deviation of change in consumption

** $p < .01$

Table 3.--Impact of the intervention on food consumption in children (g/day)

Foods	23 months or less (n=11)				24 to 47 months (n=15)				48 to 60 months (n=11)			
	X_1	X_2	Δ	S	X_1	X_2	Δ	S	X_1	X_2	Δ	S
Milk	16.0	3.4	-12.5	37	40.2	13.6	-26.6*	44	20.2	26.5	6.4	53
Eggs	9.0	6.2	- 2.8	13	13.9	12.5	- 1.4	8	14.8	12.7	- 2.1	14
Meat	6.5	7.3	0.7	4	18.3	22.8	4.5	16	21.5	12.2	- 9.4	17
Beans	6.7	8.3	1.5	19	10.8	9.7	- 1.1	12	27.0	14.4	-12.6	26
Corn	78.3	63.6	-14.6	44	133.3	134.5	1.3	30	186.9	164.1	-22.8	49
Wheat products	13.4	10.8	- 2.6	16	13.0	9.3	- 3.7	13	11.1	4.7	- 6.4	15
Rice	10.8	7.7	- 2.8	17	7.5	5.3	- 2.2	12	9.4	12.2	2.8	13
Refined sugar	21.1	30.1	8.2	13	21.3	25.9	4.7	19	32.0	36.0	4.0	17
Unrefined sugar	7.7	11.8	4.5	12	28.3	35.5	7.2	33	21.7	17.8	- 3.9	14
Fats	2.6	1.0	- 1.5	5	1.3	1.9	0.6	2	1.8	1.4	0.4	1
Cookie	0.0	40.0	40.0**	35	0.0	57.3	57.3**	12	0.0	70.4	70.4**	19

X_1 Consumption before the intervention

X_2 Consumption during the intervention

Δ Change associated withthe intervention (X_2-X_1)

S Standard deviation of change in consumption

** $p < .01$

Table 4.--Estimates of the impact of the intervention on the energy and the protein amounts provided by the usual foods

Group	Energy (kcal/day)			Protein (g/day)		
	Net change Δ_1	Provided by cookie Δ_2	Change in usual diet $\Delta_2-\Delta_1$	Net change Δ_1	Provided by cookie Δ_2	Change in usual diet $\Delta_2-\Delta_1$
Adult						
Men	173	255	- 82	-1.4	4.1	-5.5
Women	201	239	- 38	-1.3	3.8	-5.1
Children						
23 months or less	140	152	- 12	1.0	2.4	-1.4
24 to 47 months	241	217	24	3.4	3.5	-0.1
48 to 60 months	133	267	-134	-3.5	4.3	-7.8

Δ_1 Changes in intake (from Table 1)

Δ_2 Nutrient contribution of cookie consumption (estimated from Tables 2 and 3 and the nutrient composition of the cookie) was no replacement (5, 6). Data from a longitudinal study conducted in Guatemala, where considerable efforts were made to obtain valid longitudinal data on dietary intakes, suggest a 10% replacement in home diet calories as a result of a high-energy, high-protein supplement (10).

Similarly, replacement data for supplementation programs where food is provided to be consumed at home is available from only a few studies. In Guatemala, amounts of the local staples, corn and beans, were provided every 15 days to poor rural populations (11). The authors detected a low level of replacement of calories and protein of home diets of adults and children. Total energy intakes increased by 424, 404, and 196 calories respectively in men, women, and children under six years of age. More substantial increases were observed in individuals in the lowest tercile of intake prior to the intervention (i.e., 694 and 655 calories in men and women respectively). As the amounts of food provided were equivalent to 653 calories and 30 g of protein per individual, it would appear that some of the food provided was saved for later consumption. In India, 75% of families receiving a mixture of soy, corn, and milk intended for mothers and children under 48 months in age reported that the supplement was shared by older siblings and other family members (8, 9). The supplement provided 800 calories and 40.4 g of protein per mother per day and a half of that per child. Food collection rates were around 50% of what the families were entitled. Net energy increments in children under 24 months were small and no replacement of home calories was observed. In children 12 to 23, 24 to 35, and 36 to 48 months of age, the supplement added 147, 200, and 188 calories respectively to the home diets. No replacement was observed in children 12 to 23 months of age while in older children usual intakes appeared to have decreased by 3%. Net increments in energy intake were 200 for nursing mothers and only 91 calories for pregnant women. It appears that much of the supplement was consumed by other family members. Much higher replacement levels have been reported for a home supplementary feeding program for pregnant women in Colombia (12). Locally known foods were distributed to families with the target individuals being pregnant women and children with a weight-for-age less than 85%. Nutrient intakes of mothers increased by 133 calories and 20.0 g of protein. As in the Guatemalan experience (11), mothers with lower initial intakes had higher net gains. The impact would have been much greater (i.e., 493 calories and 26.8 g protein) had usual intakes not decreased by 360 calories and 6.8 g of protein. It was estimated that from 30% to 50% of the supplement was not used by the mothers but was instead consumed by other family members and/or sold to others. Finally, net increments of 200 calories for pregnant women were recorded in India for a take-home supplementary feeding program (13). The authors also noted that food was diverted to other family members, especially children 2 to 6 years of age.

The results of the present study, as well as those of other studies reviewed, do show that it is possible to improve the intakes of target individuals through food supplementation programs. The findings underscore, at the same time, that investigations of replacement should accompany every supplementation program as the levels can be highly variable. As feeding programs are usually expensive, pilot studies should be devised to identify the optimal design for maximizing the objectives of the program. Field trials, acceptability tests, and replacement studies should be carried out for the most promising supplementation designs. At the very least, the designs should test various distribution strategies and the efficacy of various supplements in achieving the desired nutritional changes. In all cases, planners should be guided by locally executed studies.

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