The impact of ordinary illnesses on the dietary intakes of malnourished children

R. Martorell,[1] *C. Yarbrough,*[2] *S. Yarbrough,*[3] *and R.-E. Klein*[4]

ABSTRACT The effect of respiratory infections, diarrhea, illness-induced apathy, and of a summary variable of selected common symptoms on food intake was estimated from data collected on preschool children from rural Guatemala. The presence of selected common symptoms was associated with an average reduction in daily intake of nearly 20%, equivalent to 175 kcal and 4.8 g of protein. Effects were of similar magnitude for diarrhea and for apathy but lower for respiratory infections, namely 61 kcal and 1.0 g of protein. It is concluded that common illnesses are an important cause of low dietary intakes in children from Guatemala. *Am. J. Clin. Nutr.* 33: 345-350, 1980.

Briscoe (1) recently attempted to develop a framework for evaluating the nutritional impact of health programs and found that much of the required quantitative data were lacking. He concluded that while the metabolic effects of infection were well known, the nutritional impact of the malabsorption associated with diarrheal diseases had been overestimated. Moreover, Briscoe (1) was "somewhat surprised" by the virtual absence of published quantitative data on the effect of different infections on the food intake of children. His surprise, as well as ours, stems from the fact that most publications on the subject of nutrition-infection interactions ascribe great importance to the effect of infection on food intake. Indeed, Mata et al. (2) have postulated that it is the frequent infections that children from developing countries have, rather than the lack of food per se, which largely account for their low dietary intakes.

Quantitative estimates of the dietary effects of common morbidity symptoms are provided in the present paper for rural Guatemalan children. The symptoms studied include the common cold and diarrheal diseases, two of the most important causes of morbidity in developing countries.

Methods

Population

The data come from a recently completed longitudinal study of malnutrition and mental development which took place in four small villages in Guatemala.[5] Central to this study was a food supplementation program in which two of the villages received a high-protein, high-calorie supplement (6.1 g and 91 kcal/100 ml) and two a low-calorie drink (no protein and 33 kcal/100 ml). Because intake of the high-protein, high-calorie supplement was substantial relative to home diets (3), only data from the communities receiving the low calorie supplement are used to test the hypothesis that illnesses reduce home dietary intakes. Interference from the low-calorie supplement is minimal because the average energy intake from this supplement was 28 kcal/day from 15 to 36 months of age and 63 kcal/day from 36 to 60 months of age. Moreover, home diet calories and supplement calories were unrelated (3).

Background data on the nutritional and health status of the children are provided elsewhere (3-5). Chronic protein-calorie malnutrition and high prevalences of respiratory and gastrointestinal illness were salient characteristics. A vaccination and curative medical care program, staffed by paramedical personnel under the supervision of a physician, operated throughout the course of the study. These services are now provided by the Guatemalan government.

[1] Associate Professor of Nutrition, Food Research Institute, Stanford University, Stanford, California 94305. [2]Statistician, Computers for Marketing Corporation, San Francisco, California 94105. [3]Student, School of Nursing, San Francisco State University, San Francisco, California 94132. [4]Director, Division of Human Development, Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, Guatemala.

[5] The longitudinal study was carried out by the Division of Human Development, Institute of Nutrition of Central America and Panama, Guatemala City, Guatemala. Support for data collection was by Contract PH43-65-640 from the National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland 20014.

Morbidity survey

Mothers were interviewed every 2 weeks about the health of their children. They were asked to recall any symptoms their children younger than 7 years might have had during the previous 2 weeks and the beginning and ending dates of each symptom were recorded. The quality control measures included periodic standardizations with a supervisor and routine inspections of the coded forms. The methodology is described in greater detail elsewhere (4, 6).

Information about 44 distinct symptoms was collected. Four morbidity indicators were constructed from these data for the purposes of this study. Frequency of occurrence (6) and likelihood of having an effect on diet were the criteria for selection. The four indicators are described below.

Respiratory infections. This variable was defined by the presence of symptoms of upper respiratory infections (nasal discharge, sore throat) and/or lower respiratory infections (soreness of chest, shortness of breath).

Diarrhea. Any report of loose stools, whether accompanied or not by mucous and/or blood and irrespective of the number of daily evacuations, was taken as evidence of diarrhea.

Apathy. Any report of the child not being "his usual self." Mothers might have complained of the child not wanting to play or eat as usual or that he was a "crybaby" or uncommonly irritable. This symptom almost always occurred in conjunction with respiratory or gastrointestinal symptoms, the most common complaints.

Summary variable, designated as SC (selected common) symptoms. This variable was designed to include common but important symptoms from the point of view of nutrition and health. It was defined by the presence of any of the following items: diarrhea, apathy, fever, vomiting, signs of a rash or of any other indication of a communicable disease, and being so ill as to be confined to bed. The SC variable is largely a reflection of diarrhea and apathy because the other symptoms were reported with less frequency (6).

Home dietary survey

Dietary intake data were collected by the same interviewers responsible for the morbidity survey. Dietary surveys were carried out for all children at 3-month intervals from 15 to 36 months of age and at 6-month intervals thereafter. The mother was asked to report all amounts of foods consumed by the child during the preceding day (one village) or preceding 3 days (one village). Only data referring to the 24 hr prior to the interview are used in this report. The information regarding cooking recipes and amounts consumed at every meal and between meals were recorded in precoded forms and estimates of nutrients consumed were obtained from food composition tables developed for Central America. Two variables have been selected for the present study, energy and protein intake.

Sample used

The study began in 1969 but the morbidjty methodology was not implemented in its final form till July 1970. The data for this study were collected from July 1970 to February 1977, when the study ended.

Cases were identified that had both morbidity and dietary data about the same 24-hr period. A total of 3439 such "days" were identified. The total number of children involved in this study is 477 and each child is represented by an average of 7.2 observations. The prevalence of illness on the selected 3439 days did not differ significantly from that observed in the total sample.

Results

Age-sex specific comparisons of home dietary energy intakes are presented in Table 1 for children with or without SC symptoms. In all but one of the comparisons, intakes are higher when no SC symptoms are present than when they are. The differences are sta-

TABLE 1
Home dietary energy intake (kcal/day) for boys and girls with or without SC symptoms

Age	Males				Females				Pooled SD
	Healthy		Sick		Healthy		Sick		
	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	n	$\bar{X}$	
mo									
15	83	572	40	520	69	581	31	480	310
18	85	692	44	555	74	626	26	477[a]	301
21	102	767	41	646	71	662	29	482[a]	325
24	116	839	28	721	85	803	20	582[b]	331
27	121	872	26	827	82	860	29	690[a]	308
30	119	946	42	771[b]	95	863	23	606[b]	342
33	135	996	27	822[a]	101	929	22	799	348
36	148	1002	26	872	107	944	27	755[a]	365
42	171	1074	24	757[c]	116	999	23	738[b]	364
48	172	1106	23	872[b]	141	1042	17	844[a]	371
54	176	1146	14	959	131	1092	23	748[c]	384
60	162	1164	19	889[b]	137	1088	16	1112	375

[a] $P < 0.05$. [b] $P < 0.01$. [c] $P < 0.001$.

tistically significant ($P < 0.05$) in five of 12 occasions for boys and in nine out of 12 for girls. When the sexes are pooled as in Figure 1, all but one of the age specific comparisons are statistically significant ($P < 0.05$). Differences between healthy and sick children appear to increase with age, averaging 143 kcal/day from 15 to 36 months of age and 237 kcal/day thereafter. Over all ages, the average difference is 175 kcal/day. If the same differences are expressed as a percent of the intake of healthy children, the age pattern noted above largely disappears. The reduction in intake is 18% from 15 to 36 months in age, 22% from 42 to 60 months, and 19% across all ages. Table 2 shows that there is also an average difference of 4.8 g of protein per day, or an 18% decrement in intake,

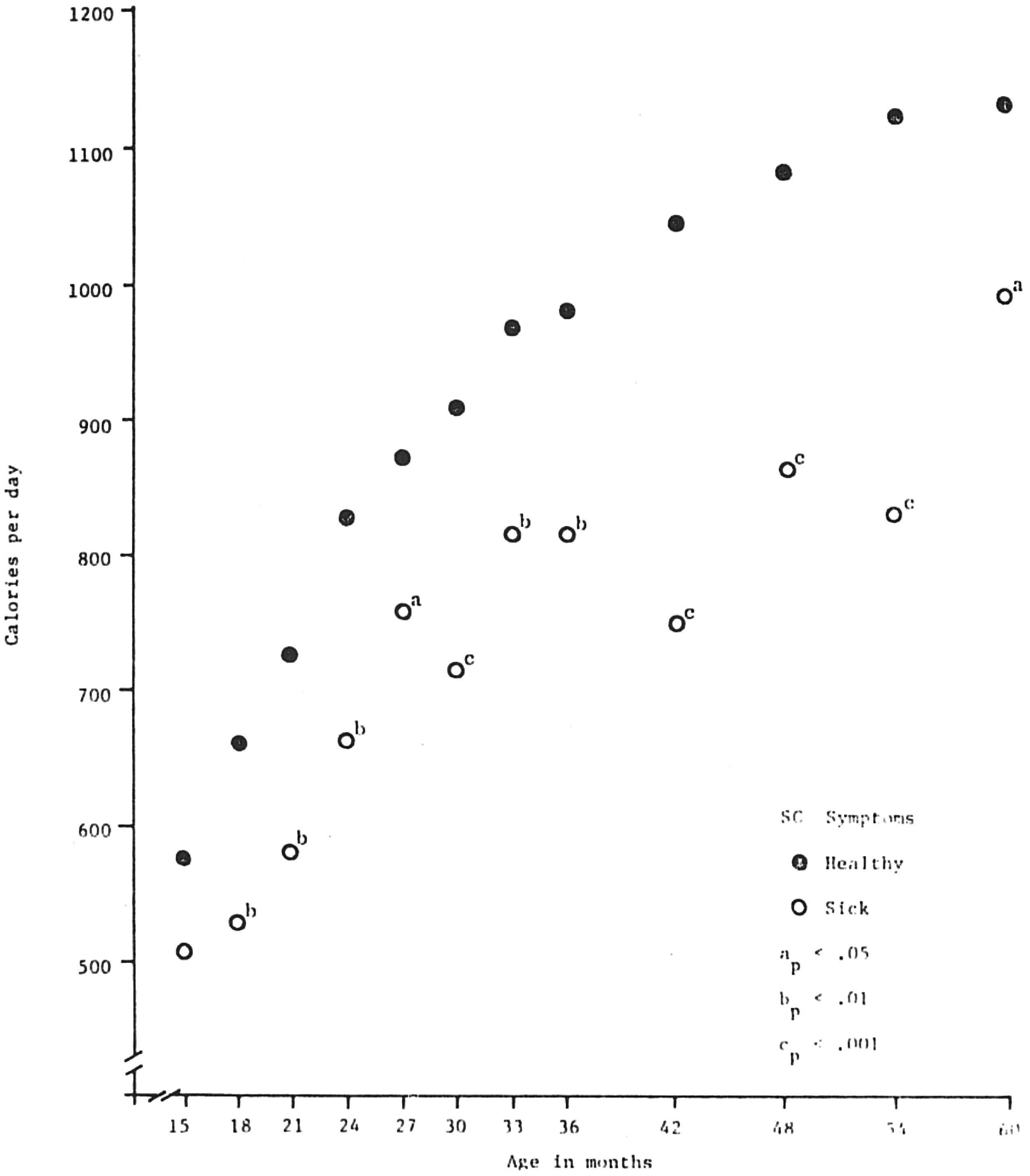

FIG. 1. Comparison of home dietary energy intake for children with or without SC symptoms (sexes pooled)

TABLE 2
Average decrement in intake associated with the presence of specific symptoms

Symptom	Energy (kcal/day)			Protein (g/day)		
	Average effect	F*	P	Average effect	F*	P
Respiratory illness	− 67	60.5	<0.001	−1.0	7.3	0.007
Diarrhea	−160	29.2	<0.001	−3.0	11.9	<0.001
Apathy	−175	98.4	<0.001	−5.1	101.2	<0.001
SC	−175	122.9	<0.001	−4.8	110.2	<0.001

* F and P are for an analyses of variance where the independent variables are age (11 groups) and presence or absence of the symptom. The dependent variable is either energy or protein. Degrees of freedom are 1/3438. The findings remain unchanged when dummy variables for either sex or village are added as independent variables.

associated with the presence of SC symptoms. Differences of similar magnitude as for SC symptoms were also found for diarrhea and apathy (Table 2). The association with respiratory illnesses, though statistically significant, was of lesser magnitude (Table 2).

Children with dietary data on two separate occasions were then identified. Two groups were selected for analyses: those sick with SC symptoms at the earlier period but with none in the second period and conversely, those healthy earlier and sick later. Table 3 shows the mean differences, always the later minus the earlier period, after adjusting for age effects. When a child changes from being sick to being healthy, his intake goes up by an average of 125 kcal/day. Conversely, when the change is from healthy to sick, his intake drops by an average of 148 kcal/day.

TABLE 3
Differences in energy intake, after adjusting for age effects, associated with changes in health (SC symptoms) in the same child.

Periods	Age adjusted changes*			
	Sick to well		Well to sick	
Later-earlier	n_1	Δ_1	n	Δ
mo				
18-15	80	85	80	− 58
21-18	82	86	82	−134
24-21	83	72	83	−150
30-24	60	60	60	−179
36-30	74	142	74	−178
42-36	71	63	71	−180
48-42	55	214	55	−167
60-48	38	278	38	129

* Adjustments for age effects were made as follows: First, the increment observed in healthy children from one age to another was obtained from Figure 1. This number was then subtracted from the mean age change observed for both "sick to well" and "well to sick" children to obtain Δ. The sample size is denoted by n.

Discussion

The results presented here indicate that reduced home dietary intakes are associated with the presence of certain morbidity symptoms of common occurrence in preschool-age Guatemalan children. The variables studied included diarrheal diseases, apathy, respiratory problems, and a summary indicator of SC symptoms. On an average, the presence of SC symptoms was associated with a decrement of 175 kcal/day or 19% of intake. The corresponding data for protein intake are 4.8 g or 18% of intake.

There was a remarkable consistency in the findings when the sample was broken down by age (11 groups) and sex. All but one of the 22 comparisons between healthy and sick children were in the expected direction and 14 were statistically significant ($P < 0.05$). The above "between children" analyses were replicated in "within child" comparisons. The unit of analyses in the latter type was the individual child and individual changes in diet were related to changes in health (SC symptoms). A change from sick to healthy was associated with an increment of 125 kcal/day while the converse, a change from healthy to sick, was associated with a decrease of 148 kcal/day. These analyses are of particular importance because they control for factors which are constant to the child (i.e., village, birth order, socioeconomic status, etc.) and for systematic biases in reporting.

The low-calorie supplement provided to the village children had little impact on the infection-diet relationships studied. For example, children attended the supplementation center 60.6% of the time when they were free from SC symptoms and 57.3% of the

time when they reported SC symptoms. These differences, while statistically significant, are minor. Thus, the effect of SC symptoms on total intake would have been only slightly larger had we corrected for the supplementation factor.

Our findings are in agreement with the studies by Lechtig et al. (7) and Mata et al. (2) who showed negative associations between illness and diets in pregnant women and in children respectively. Also, Beisel et al. (8) found that infections led to reduced intakes in adult male subjects participating in clinical studies.

Many textbooks and articles point out that illnesses will be accompanied by anorexia and reduced dietary intakes. Yet, we are unaware of any study which has provided the necessary data to estimate the mean impact of ordinary illnesses on the dietary intakes of chronically malnourished populations. This task requires one to know the frequency of such illnesses in the population and their average effect on dietary intakes. From Table 1, it can be inferred that on the average 23% of the children studied will exhibit SC symptoms on any given day. If the average effect of being sick with SC symptoms is 175 kcal/day, then it could be argued that the mean energy intake would be higher by 40 kcal/day (i.e., 0.23 × 175 kcal/day) if all children were free from SC symptoms. This may seem like a small amount but yet, the mean energy deficit, estimated by multiplying the actual body weights (5) by the age specific Food and Agricultural Organization/World Health Organization energy requirements per kilogram of body weight (9), is of the order of 225 kcal/day. In other words, at least 18% (i.e., 40/225 kcal/day) of the mean energy deficit may be explained by the effect of SC symptoms on food intake.

These effects are likely to be minimum estimates of the impact of disease on dietary intakes in developing countries. Many infectious episodes are asymptomatic and many children reported as healthy may in reality be sick. Our analyses did not include all of the symptoms reported in the study communities. Furthermore, the methodology utilized underestimates the prevalence of symptoms for mothers often fail to report symptoms that their children had either because they did not become aware of the problems or because they simply forgot about them (4, 6). Nonetheless, even an agressive adjustment for underestimation, by as much as 50% or even 100% would still yield results which do not corroborate the hypothesis of Mata and coworkers (2) to the effect that infections account for *most* of the energy deficits observed in children from developing countries. This is not to say, however, that infections are not important causes of low dietary intakes. Certainly, the finding that at least one-fifth of the energy deficit is due to infection has profound biological significance.

There are also other mechanisms that would have to be considered in evaluating the full impact of infection on nutrition. These factors have to do with food utilization and include the loss of nutrients through vomiting, the malabsorption of diarrheal diseases, and the various metabolic effects of illness processes (1, 10). For all these reasons, therefore, illnesses must be included as one of the major causes of malnutrition in developing countries and must be considered by all programs aimed at improving nutritional status. It is recommended that careful analyses be given to the formulation of programs designed to alleviate malnutrition for certain kinds of health interventions may prove more cost-effective than traditional approaches such as food supplementation programs.

References

1. Briscoe, J. The quantitative effect of infection on the use of food by young children in poor countries. Am. J. Clin. Nutr. 32: 648, 1979.
2. Mata, L. J., R. A. Kromal, J. J. Urrutia and B. García. Effect of infection on food intake and the nutritional state: perspectives as viewed from the village. Am. J. Clin. Nutr. 30: 1215, 1977.
3. Martorell, R., A. Lechtig, C. Yarbrough, H. Delgado and R. E. Klein. Energy intake and growth in an energy deficient population. Ecol. Food Nutr. 7: 147, 1978.
4. Martorell, R., J.-P. Habicht, C. Yarbrough, A. Lechtig, R. E. Klein and K. A. Western. Acute morbidity and physical growth in rural Guatemalan children. Am. J. Diseases Children 129: 1296, 1975.
5. Yarbrough, C., J.-P. Habicht, R. Malina, A. Lechtig and R. E. Klein. Length and weight in rural Guatemalan Ladino children birth to seven years of age. Am. J. Phys. Anthropol. 42: 439, 1975.
6. Martorell, R., J.-P. Habicht, C. Yarbrough, A. Lechtig and R. E. Klein. Underreporting in fortnightly recall morbidity surveys. J. Trop. Pediat. 22:

129, 1976.
7. LECHTIG, A., J.-P. HABICHT AND G. G. GUZMÁN. Morbilidad materna y crecimiento fetal en poblaciones rurales de Guatemala. Arch. Latinoamer. Nutr. 22: 255, 1972.
8. BEISEL, W. R., W. D. SAWYER, E. D. RYLL AND D. CROZIER. Metabolic effects of intracellular infections in man. Ann. Internal Med. 67: 744, 1967.
9. Food and Agricultural Organization/World Health Organization. Energy and Protein Requirements. Report Series no. 522. Geneva: World Health Organization, 1973.
10. SCRIMSHAW, N. S., C. E. TAYLOR AND J. E. GORDON. Interactions of Nutrition and Infection. World Health Organization Monograph Series no. 57. Geneva: World Health Organization, 1968.