

EPIDEMIOLOGY OF ACUTE RESPIRATORY INFECTIONS IN PRESCHOOL CHILDREN OF RURAL GUATEMALA¹

*Hernán L. Delgado,² Elsa Marina Girón,²
Helen de León de Ramírez,² and Elena Hurtado²*

INTRODUCTION

Acute respiratory infections, together with diarrheal diseases and malnutrition, are the leading causes of morbidity and mortality in children under five years of age in developing countries (1, 2). In the specific case of Central America, acute respiratory infections in this age group are responsible for 25% to 50% of all pediatric consultations at official health services, and for 5% to 20% of all mortality in the same age group (3). Given the magnitude of the problem, all the Central American countries and Panama, following the technical recommendations of international experts (4), have begun activities designed to

control acute respiratory infections within the framework of their integrated five-year plans for child survival (5).

Despite this, however, the epidemiology of acute respiratory infections in Central America and Panama is not yet well understood. More specifically, the causes of differences in the morbidity and mortality reported in different countries, and even in different parts of the same country, have not been properly identified (6). It is true that the available literature reports results—sometimes contradictory ones—regarding factors linked to the incidence and duration of acute respiratory infections in preschool children—factors such as breast-feeding and early weaning (7–10), housing characteristics, sanitary and socioeconomic conditions, overcrowding, seasonal fluctuations (11, 12), and nutritional status (13, 14). However, few studies have been conducted on the epidemiology of respiratory diseases in the Central American region.

Within this context, the purpose of the work reported here was to examine relationships between socioeconomic, environmental, and nutritional features on the one hand, and respiratory infections on the other, in children under two years of age residing in rural areas of Guatemala.

¹ This article has previously been published in Spanish in the *Boletín de la Oficina Sanitaria Panamericana*, vol. 104, no. 5, pp. 429–439, 1988. The work reported here was carried out with the support of the Agency for International Development (Contract No. AID/ta-C/1342 and AID Grant No. 596-0115), the World Health Organization (Contract N3/445/9), and the Institute of Nutrition of Central America and Panama (INCAP).

² Nutrition and Health Division, INCAP, Apartado Postal 1188, 01901 Guatemala City, Guatemala.

MATERIALS AND METHODS

Between 1977 and 1980, the Institute of Nutrition of Central America and Panama (INCAP) conducted a longitudinal project on health and nutrition among indigenous populations residing permanently on 12 coffee plantations. A population census performed as part of the project found the total 1977 population of permanent residents on these plantations to be approximately 7,000.

The plantations were located along the southern coast of Guatemala, near the town of Patulul in Suchitepéquez Department. The altitude of this region is roughly 75 meters above sea level, and its annual average rainfall is 150 millimeters. A rainy season lasts from April through September and a dry season from October through March. The annual average temperature, without major seasonal variations, is around 28°C (15).

In coordination with the Ministry of Health of Guatemala, and with the assistance of the plantation owners, INCAP established a simplified health care program on each plantation run by health promoters under the close supervision of the project's nursing auxiliaries and physicians. The promoters, selected by each plantation's management from among the plantation workers and residents, were trained in the use of an operations manual prepared by INCAP (16, 17). This manual included a simplified therapeutic guide for clinical management of patients visiting the clinics set up at each plantation. A total of 16 promoters—all women—were trained so as to provide an average of at least one promoter per 100 families, or about one per 500 residents.

In handling clinic visits for acute respiratory infections, the project

health personnel³ used the therapeutic guide, which described the signs and symptoms of the most common respiratory infections and indicated the therapeutic procedures to follow in each case. The project's health personnel were instructed in the standardized use of this guide, and a strict system of supervision was maintained by the physicians and nursing auxiliaries to ensure that the patients received good-quality health care. All information obtained from the clinic visits was recorded on precoded forms for subsequent computer analysis.

In addition to providing health services, the project collected morbidity data from individual residences. During the first year, between September 1977 and October 1978, all families residing on the plantations were visited every two weeks. Adequately trained interviewers used a standardized form to collect longitudinal data on signs and symptoms presented by children under five years of age during the two weeks preceding the visit. (The analysis reported here includes children up to two years of age.) In each case, information was obtained on the following respiratory signs and symptoms: nasal secretions, cough, and stridor and "rattle" in the chest. Information was collected on the date of onset and termination of each symptom, so as to permit study of its frequency and duration.

³ Including physicians, auxiliary nurses, and health promoters.

These fortnightly home survey data, together with data on the signs and symptoms responsible for clinic visits by the same children, permitted comparison of morbidity in the home with respiratory symptoms for which services were sought at each plantation clinic. These data were analyzed to determine the average duration and number of episodes of each symptom during each quarter of the year. An absence of symptoms for three or more days was the criterion used to differentiate one episode from another.

The project also compiled prospective information on the physical growth of preschool children in each quarter. This information was analyzed to determine Z point scores⁴ resulting from comparison of internationally recommended WHO anthropometric population reference data on weight-for-age, weight-for-length, and length-for-age (18). If the distribution of the project population were statistically normal, no more than 2.5% of the children should have been found below 2.00 standard deviations from the mean, and no more than 16% below 1.00 standard deviations from the mean. Those children included in the analysis were those under two years old from whom anthropometric data were obtained at the beginning and end of each quarter of the study.

Finally, data were gathered on the socioeconomic characteristics of the study population. Because the study population consisted of the children of permanent farm workers with similar salaries and benefits (e.g., housing and services furnished by the plantation), its socioeconomic status proved to be quite homogeneous. Typical housing on these plantations consisted of a dwelling with a

wood-burning stove for cooking. Some families had modified their dwellings by doing such things as placing the kitchen outside the house.

RESULTS

Table 1 presents October 1977–September 1978 information by quarter on children under two years of age within the study areas—including data on physical growth measurements, respiratory symptoms, and utilization of health services. The anthropometric data are expressed as the percentages of children under two years of age who were over 2 standard deviations below the weight-for-age standard, over 1 standard deviation below the weight-for-length standard, and over 3 standard deviations below the length-for-age standard. The weight-for-age and length-for-age data showed high percentages of the study children to exhibit delayed growth in terms of both weight and length, while the weight-for-length data pointed to acute nutritional problems.

With respect to respiratory disease morbidity, children under two years of age manifested nasal secretion for a greater length of time (approximately 30% of each quarter) than they manifested cough (about 13% of each quarter) or stridor and “rattle” (4% of each quarter). The average number of episodes of nasal secretion, productive cough, and stridor and “rattle” per quarter were 1.1, 0.5, and 0.2, respectively.

⁴ Z score = the number of standard deviations from the mean.

TABLE 1. Anthropometric indicators, symptoms of acute respiratory infection, and health services utilization among indigenous children under two years of age in the study areas of Guatemala. Data on respiratory symptoms and health services utilization are given in terms of averages plus or minus 1 standard deviation (SD).

Characteristics of the children	Quarter			
	Oct-Dec 1977	Jan-Mar 1978	Apr-June 1978	July-Sept 1978
<i>Number of cases</i>	131	233	280	257
<i>Anthropometry:</i>				
Weight-for-age (% > 2 SD below the international reference standard)	44.2	49.9	42.1	42.4
Weight-for-length (% > 1 SD below the international reference standard)	19.8	22.6	17.5	17.7
Length-for-age (% > 3 SD below the international reference standard)	39.6	34.9	36.5	31.7
<i>Symptoms of acute respiratory infection:</i>				
<i>Nasal secretion:</i>				
Frequency (average no. of episodes per quarter ± 1 SD)	1.29 \pm 0.81	1.14 \pm 0.83	1.22 \pm 0.88	0.90 \pm 0.79
Average % of quarter spent with symptom ± 1 SD	23.9 \pm 22.1	28.6 \pm 26.9	35.6 \pm 31.7	31.4 \pm 30.8
<i>Cough:</i>				
Frequency (average no. of episodes per quarter ± 1 SD)	0.63 \pm 0.64	0.54 \pm 0.64	0.59 \pm 0.73	0.37 \pm 0.57
Average % of quarter spent with symptom ± 1 SD	12.1 \pm 18.5	13.4 \pm 20.6	14.5 \pm 21.8	11.3 \pm 21.8
<i>Stridor and "rattle":</i>				
Frequency (average no. of episodes per quarter ± 1 SD)	0.24 \pm 0.53	0.22 \pm 0.50	0.21 \pm 0.46	0.13 \pm 0.34
Average % of quarter spent with symptom ± 1 SD	4.4 \pm 11.5	4.8 \pm 14.1	4.3 \pm 13.9	4.2 \pm 14.5
<i>Utilization of health services:</i>				
Average number of visits to clinics for ARI ± 1 SD	0.69 \pm 1.02	0.43 \pm 0.87	0.41 \pm 0.74	0.38 \pm 0.68

The greatest frequency of respiratory symptoms was seen in a part of the dry season (October–December), and to a lesser extent in a part of the rainy season (April–June). However, these seasonal differences were not found to be statistically significant; and for that reason the analyses presented here used data from the two seasons combined.

The average number of visits to clinics for respiratory problems was approximately 0.5 per quarter.

Analysis of data on the visits to clinics for specific symptoms relating

to those detected by means of the fortnightly home surveys revealed that the health services were relatively underutilized. That is, the likelihood that services would be requested if a specific respiratory symptom were present was 36%, 29%, and 43% for nasal secretion, cough, and stridor and "rattle," respectively.

Table 2 presents data on relationships between respiratory symptoms on the one hand and socioeconomic and housing conditions on the other. Regarding the average frequency and duration of respiratory symptoms, several statistically significant differences were found. Specifically, children from families with an illiterate as compared to a literate head of household were found to have a significantly longer average duration of nasal secretion; those living in houses without indoor drinking-water supplies had a significantly greater average duration and frequency of cough and of stridor and "rattle"; those living in homes with excreta disposal facilities had a significantly greater duration of cough; and children living in permanent housing had a significantly lower frequency and duration of stridor and "rattle."

Relationships between respiratory morbidity and nutritional status estimated by anthropometric measurements are shown in Table 3. Children were classified as being low, medium, or high in terms of weight-for-age, length-for-age, and weight-for-length, and for each group the average frequency and duration of nasal secretion, cough, and stridor and "rattle" were calculated. As shown in the table, children with relatively better nutritional status (as indicated by weight-for-length) had a greater average incidence and duration of cough and of stridor and "rattle" than children with poorer nutritional status. However, no statistically significant symptomatic differences were found among the children with relatively greater or lesser weight-for-age or length-for-age.

Finally, relationships between symptoms of respiratory infection, use of health services, and changes in quarterly anthropometric measurements (indicative of nutritional status) were examined in the study children (Table 4). The anthropometric changes occurring in each

quarter were expressed as changes in the Z scores of weight-for-age, weight-for-length, and length-for-age. Specifically, changes in quarterly Z scores (± 1 SD) were found for children without respiratory disease symptoms, and also for those with nasal secretion, cough, or stridor and "rattle." For those with each of these symptoms, separate values were found for the children using health services and those not using health services.

As Table 4 shows, the Z scores for all groups (with and without symptoms) showed negative anthropometric changes indicative of the growth retardation process in children under two years of age in this population. However, relatively greater average growth retardation was found among study children with one or more episodes of respiratory symptoms than among those who presented no respiratory symptoms. Finally, quarterly data on the children with nasal secretion and cough who used health services suggested they experienced more growth retardation (as indicated by their average Z scores) than did children with the same symptoms who did not use the health services. However, the situation was reversed in the case of stridor and "rattle," with those who did not use health services showing more growth retardation.

These physical growth differences between children who used the health services and those who did not are not statistically significant and could merely reflect differences in the severity

TABLE 2. Frequency and duration of acute respiratory infection symptoms per quarter, among children under two years old, by indicators of socioeconomic status and housing quality.

		Nasal secretion		Cough		Stridor and "rattle"	
	No. of cases	% of time with disease ± 1 SD	No. of episodes ± 1 SD	% of time with disease ± 1 SD	No. of episodes ± 1 SD	% of time with disease ± 1 SD	No. of episodes ± 1 SD
<i>Literacy of head of household:</i>							
Illiterate	418	32.5 ± 30.0 ^a	1.17 ± 0.84	13.9 ± 20.8	0.55 ± 0.66	5.2 ± 13.9	0.22 ± 0.59
Literate (reads and writes)	273	27.2 ± 27.6 ^a	1.10 ± 0.86	12.5 ± 21.7	0.50 ± 0.64	3.5 ± 13.4	0.16 ± 0.40
<i>Cooking:</i>							
In the house	431	31.6 ± 28.9	1.18 ± 0.85	12.9 ± 19.3	0.65 ± 0.54	3.8 ± 11.1	0.19 ± 0.42
Outside the house	442	30.4 ± 29.9	1.10 ± 0.82	13.7 ± 22.6	0.52 ± 0.67	4.6 ± 14.2	0.21 ± 0.49
<i>Water supply:</i>							
Inside the house	74	31.2 ± 30.3	1.12 ± 0.83	9.3 ± 19.5 ^a	0.39 ± 0.57	1.6 ± 6.2 ^a	0.08 ± 0.28
Outside the house	808	30.9 ± 29.2	1.13 ± 0.84	13.5 ± 21.1 ^a	0.54 ± 0.66	4.5 ± 13.4 ^a	0.21 ± 0.47
<i>Excreta disposal facilities:</i>							
None	840	31.0 ± 29.3	1.13 ± 0.82	12.9 ± 20.3 ^b	0.52 ± 0.65	4.2 ± 12.9	0.19 ± 0.45
Sanitary facility	41	31.2 ± 28.8	1.31 ± 1.10	20.6 ± 31.0 ^b	0.63 ± 0.73	5.7 ± 17.4	0.27 ± 0.59
<i>Breast-feeding:</i>							
None	406	31.4 ± 29.0	1.19 ± 0.82	13.3 ± 21.2	0.55 ± 0.68	4.3 ± 13.7	0.22 ± 0.50
Exclusive breast-feeding	175	34.0 ± 28.8	1.25 ± 0.80	13.7 ± 20.6	0.54 ± 0.65	3.7 ± 12.2	0.17 ± 0.40
<i>Housing:</i>							
Hut	174	31.6 ± 33.2	1.14 ± 0.82	12.3 ± 19.0	0.53 ± 0.67	6.4 ± 16.6 ^a	0.26 ± 0.54
Permanent construction	343	29.5 ± 29.7	1.06 ± 0.80	13.7 ± 22.8	0.53 ± 0.66	3.6 ± 12.1 ^a	0.16 ± 0.40

^a T test indicates $P < 0.05$.

^b T test indicates $P < 0.01$.

TABLE 3. Frequency and duration of nasal secretion, cough, and stridor and "rattle" per quarter among study children under two years of age in different anthropometric categories. The standard deviations cited are those above or below the previously mentioned international reference standards contained in reference 18.

Anthropometric categories	No. of cases	Nasal secretion		Cough		Stridor and "rattle"	
		% of time with disease (average)	No. of episodes (average)	% of time with disease (average)	No. of episodes (average)	% of time with disease (average)	No. of episodes (average)
<i>Weight-for-age:</i>							
Low (≥ 2.00 SD below standard)	392	30.7	1.09	12.7	0.53	3.6	0.17
Intermediate (1.99–1.00 SD below standard)	255	33.3	1.26	15.0	0.56	5.6	0.24
High (0.99 SD below standard to 3.00 SD above standard)	254	28.9	1.11	11.9	0.48	4.3	0.18
<i>Weight-for-length:</i>							
Low (≥ 1.00 SD below standard)	157	32.3	1.12	10.6 ^a	0.48	2.9 ^a	0.14 ^a
Intermediate (0.99–0.00 SD below standard)	303	33.1	1.20	14.4 ^a	0.56	3.9 ^a	0.18 ^a
High (0.01–3.00 SD above standard)	370	30.7	1.18	14.2 ^a	0.54	5.9 ^a	0.24 ^a
<i>Length-for-age:</i>							
Low (≥ 3.00 SD below standard)	313	29.6	1.10	12.9	0.54	4.0	0.18
Intermediate (2.99–2.00 SD below standard)	270	34.1	1.23	14.8	0.57	5.4	0.23
High (1.99 SD below standard to 3.00 SD above standard)	305	28.9	1.11	11.5	0.47	4.0	0.17

^a By analysis of variance, $P < 0.05$.

TABLE 4. Quarterly changes in weight and length in study children 0-2 years old, by presence or absence of nasal secretion, cough, or stridor and "rattle" and utilization or nonutilization of health services (expressed as quarterly changes in Z scores \pm 1 SD).

Children without nasal secretion, cough, or stridor and "rattle"			Children with nasal secretion, cough, or stridor and "rattle"					
			Symptom	Anthropometric indicator	Children utilizing health services		Children not utilizing health services	
No.	Anthropometric index	Changes in Z scores (\pm 1 SD)			No.	Changes in Z scores (\pm 1 SD)	No.	Changes in Z scores (\pm 1 SD)
139	Weight-for-age	-0.14 (\pm 0.87)	Nasal secretion	Weight-for-age	184	-0.35 (\pm 0.82)	334	-0.19 (\pm 0.76)
133	Length-for-age	-0.14 (\pm 0.91)		Length-for-age	178	-0.25 (\pm 0.70)	319	-0.19 (\pm 0.60)
114	Weight-for-length	-0.18 (\pm 1.12)		Weight-for-length	172	-0.28 (\pm 1.02)	305	-0.18 (\pm 1.04)
			Cough	Weight-for-age	115	-0.33 (\pm 0.94)	181	-0.22 (\pm 0.79)
				Length-for-age	113	-0.20 (\pm 1.06)	176	-0.17 (\pm 0.63)
				Weight-for-length	106	-0.32 (\pm 1.00)	167	-0.21 (\pm 1.07)
			Stridor and "rattle"	Weight-for-age	46	-0.29 (\pm 0.62)	61	-0.31 (\pm 0.80)
				Length-for-age	68	-0.22 (\pm 0.76)	100	-0.24 (\pm 0.66)
				Weight-for-length	54	-0.25 (\pm 0.67)	55	-0.31 (\pm 1.09)

of the symptoms for which services were or were not sought, especially in the case of nasal secretion and cough. This appears reasonable, since (as noted previously) the chances that health services would be used when the study symptoms were present were less than 50%—even in cases presenting the most severe symptom, stridor and “rattle.”

CONCLUDING REMARKS

The study children exhibited a high incidence of acute respiratory disease symptoms, especially nasal secretion. However, the results obtained are comparable with those reported from several studies of other populations in rural areas of Guatemala (19–21). Furthermore, high prevalence of physical growth retardation and low weight-for-length indexes were also found in these other populations, respectively suggesting chronic and acute protein-energy malnutrition.

In the study reported here, correlations were found between some respiratory disease symptoms and certain socioeconomic risk factors—notably the availability of an indoor water supply, housing conditions, and literacy. However, significant relationships between these symptoms and various other factors—including location of the kitchen (and consequently indoor smoke) and breast-feeding—were not found. Since factors such as ventilation in the home were not taken into account, the validity

of the former finding is questionable. In the latter case, evidence of a link between breast-feeding and the incidence of acute respiratory disease is not conclusive (9, 22). It has been suggested that breast-feeding may have a major impact on the severity—but not the frequency—of respiratory infections (8).

However, relationships were found between respiratory symptoms and anthropometric indicators of nutritional status—notably the weight-for-length indicator that tends to reflect current nutritional status. This latter association, which suggests a greater incidence of respiratory signs and symptoms in children with better current nutritional status, has also been reported in other epidemiologic and clinical studies (21, 23) while contradicting findings from studies done in urban areas of Costa Rica and Colombia (13, 14). The extent to which these associations between the incidence of respiratory infections and nutritional status are due to interfering factors (for instance variables related to socioeconomic status) should be examined in future studies.

Our findings also demonstrate that acute respiratory infections negatively affect child growth rates in terms of length and weight, because the study children who presented one or more respiratory symptoms in a given quarter exhibited slower growth than those with no reported symptoms. The data also showed less (though not statistically significant) growth retardation among children with less severe respiratory symptoms (such as nasal secretion) as compared to those with more severe symptoms.

With the exception of children with stridor and “rattle,” medical services provided for symptoms of acute respiratory infection were not found to have had a positive effect on the nutritional status of the children studied.

Generally speaking, it may be concluded that the health services made available were underutilized, since services at the plantation clinics were sought for less than 50% of the study children under two years of age who presented symptoms. Demand resulting from more serious symptoms, such as stridor and "rattle," was greater than that resulting from more common symptoms like nasal secretion. Nevertheless, none of the symptoms involved elicited a demand for health services exceeding 50% of the cases studied.

SUMMARY

The aim of the analysis presented here was to examine patterns of acute respiratory disease in a population of rural Guatemalan children. The specific population studied had participated in a longitudinal project on health and nutrition conducted by the Institute of Nutrition of Central America and Panama at 12 coffee plantations in 1977-1980. Project data assessed in this article include the incidence and duration of three respiratory disease symptoms (nasal secretion, cough, and stridor and "rattle") among clinic patients and residents under two years old in the study areas between September 1977 and October 1978; anthropometric indicators derived from each child's length, weight, and age; and information on the study subjects' socioeconomic status.

The average number of episodes of nasal secretion, cough, and stridor and "rattle" per quarter among the study children were 1.1, 0.5, and 0.2, re-

spectively. This high incidence of acute respiratory disease symptoms is comparable to those found by several other studies of rural Guatemalan populations.

The data also suggest that available clinics tended to be underutilized, because only 36% of the children with nasal secretion, 29% with cough, and 43% with stridor and "rattle" visited the clinics. Regarding nutritional status, study children with apparently better nutritional status (as indicated by their weight-for-length) had a greater average incidence and duration of cough and stridor and "rattle." Medical services provided for children with nasal secretion or cough did not appear to have a positive effect on the children's nutritional status.

Correlations were also found between some respiratory disease symptoms and certain socioeconomic risk factors—notably the availability of an indoor water supply, housing conditions, and literacy. In addition, the findings demonstrated that acute respiratory infections affected the speed of children's growth in terms of both length and weight, because the children who had one or more of the respiratory disease symptoms studied in a given quarter exhibited slower growth than those with none of these symptoms.

REFERENCES

- 1 Organización Panamericana de la Salud. Programa de control de infecciones respiratorias agudas en la infancia. (Report.) *Bol Of Sanit Panam* 97:434-450, 1984.
- 2 Leowski, J. Mortality from acute respiratory infections in children under 5 years of age: Global estimates. *World Health Statistics Quarterly* 39:138-144, 1986.
- 3 Planes Quinquenales Integrados de Supervivencia Infantil, 1986-1990, de los países de la Subregión de Centroamérica, Belice y Pan-

amá. Documents presented at the Subregional Work Meeting on Child Survival held at Tegucigalpa, Honduras in July 1985.

- 4 Organización Panamericana de la Salud/ Organización Mundial de la Salud, UNICEF. Actividades y estado actual del programa de control de las infecciones respiratorias agudas (IRA) en la región de las Américas. Unpublished documents OPS/HPM/TRI-1987. Washington, D.C., 1987.
- 5 UNICEF. Child Survival in the Central American Isthmus: A Proposal for Special Funding. Guatemala City, 1984.
- 6 Pio, A., J. Leowski, and H. G. Ten Dam. La magnitud del problema de las infecciones respiratorias agudas. Document presented at the II Regional Seminar on Acute Respiratory Infections in Children and Child Survival. Río de Janeiro, Brazil, 1984.
- 7 Forman, M. R., B. I. Graubard, H. J. Hoffman, R. Beren, E. E. Harley, and P. Bennett. The Pima infantile feeding study: Breastfeeding and respiratory infections during the first two years of life. *Int J Epidemiol* 13:447-453, 1984.
- 8 Pullan, C. R., G. L. Toms, A. J. Martins, P. S. Gardner, J. K. G. Webb, and D. R. Appleton. Breastfeeding and respiratory syncytial virus infection. *Br Med J* 281:1034-1036, 1980.
- 9 Frank, A. L., L. H. Taber, W. P. Glezen, G. L. Kasel, C. R. Wells, and A. Paredes. Breastfeeding and respiratory virus infection. *Pediatrics* 70:239-245, 1982.
- 10 Fleming, D. W., S. L. Cochi, A. W. Hightower, and C. V. Brome. Childhood upper respiratory tract infections: To what degree is incidence affected by day-care attendance. *Pediatrics* 79:55-60, 1987.
- 11 Black, R. E., K. E. Brown, S. Becker, and M. Yunus. Longitudinal studies of infectious diseases and physical growth in rural Bangladesh: I. Patterns of morbidity. *Am J Epidemiol* 115:305-314, 1982.
- 12 Fergusson, D. M., L. J. Horwood, F. T. Shannon, and B. Taylor. Breastfeeding, gastrointestinal and lower respiratory illness in the first two years. *Aust Paediatr J* 17:191-195, 1981.
- 13 James, J. W. Longitudinal study of the morbidity of diarrheal and respiratory infections in malnourished children. *Am J Clin Nutr* 25:690, 1972.
- 14 Berman, S., A. Dueñas, A. Bedoya, V. Constan, S. León, I. Borrero, and J. Murphy. Acute lower respiratory tract illness in Cali, Colombia: A two-year ambulatory study. *Pediatrics* 71:210-218, 1983.
- 15 Valverde, V., H. L. Delgado, J. M. Belizán, R. Martorell, V. Mejía-Pivaral, R. Bressani, L. G. Elías, M. Molina, and R. E. Klein. The Patulul Project: Production, Storage, Acceptance, and Nutritional Impact of Opaque-2 Corns in Guatemala. Working document. Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, 1983.
- 16 Delgado, H. L., J. Belizán, V. Valverde, E. M. Girón, V. Mejía-Pivarel, and R. E. Klein. A Simplified Health Care Program in Rural Guatemala: The Patulul Project. INCAP Monograph Series No. 12. Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, 1980.
- 17 Delgado, H. L., V. Valverde, and E. Hurtado. Tres proyectos simplificados de atención primaria de salud y su efecto sobre la nutrición y la salud infantiles. *Bol Of Sanit Panam* 103:340-350, 1987.
- 18 World Health Organization. *Measuring Change in Nutritional Status: Guidelines for Assessing the Nutritional Impact of Supplementary Feeding Programmes for Vulnerable Groups*. Geneva, 1983.
- 19 Mata, L. J. *The Children of Santa María Cauqué: A Prospective Field Study of Health and Growth*. MIT Press, Cambridge, 1978.
- 20 Ministerio de Salud Pública y Asistencia Social/INCAP. *Encuesta de salud maternoinfantil simplificada*. INCAP, Guatemala City, 1978.
- 21 Martorell, R. Illness and Incremental Growth in Young Guatemalan Children. Doctoral Thesis. University of Washington, Seattle, 1973, 128 pp.
- 22 Taylor, B., J. Wadsworth, J. Golding, and N. Butler. Breast-feeding, bronchitis, and admissions for lower-respiratory illness and gastroenteritis during the first five years. *Lancet* 1:1227-1229, 1982.
- 23 Tracey, V. V., N. C. De, and J. R. Harper. Obesity and respiratory infection in infants and young children. *Br Med J* 1:16-18, 1971.