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Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964

VI. Acute Diarrheal Disease and Nutritional Disorders in General Disease Incidence

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A PRECEDING publication[1] described general morbidity among children less than 5 years old in three Guatemalan villages. In one population, that of Santa Catarina Barahona, hereafter referred to as the feeding village, children were provided with a food supplement sufficient to meet prescribed protein recommendations and to add materially to established caloric requirements. Medical care remained that of the usual Guatemalan village.[2] In a second community, Santa María Cauqué, designated the treatment village, an integrated medical service was introduced combining medical care, immunization against communicable disease, and village improvements in environmental sanitation. Childhood diets remained in the conventional pattern of rural Mayan Indian communities. A third village, Santa Cruz Balanyá, was the control village; deaths, illnesses, and nutritional state of children were observed, but with no additions or changes to existing nutritional or other health practices.

The outstanding finding was the dominant position of acute diarrheal disease among conditions affecting the health of children in these technically underdeveloped communities. The village with medical care had two major epidemics of diarrheal disease extending over three of the five years of observation. The first outbreak lasted two years, the second and third of the study; the second began in the final year as observations ended,[3] and its peak incidence exceeded that of the first. The medical and sanitary measures introduced did not inhibit the occurrence of the outbreaks or modify their general behavior.

The village with a food supplement had an excellent health record for the first three years. General morbidity was measurably less than in the control village and far better than in the treatment village with its prolonged epidemics of diarrheal disease and customary diet. Thereafter, participation of the children in the feeding program declined as the educational program of previous years ended and administrative difficulties intruded. Basic diets remained unchanged but fewer children received the supplement regularly. Case incidence of disease increased generally, and diarrheal disease reached epidemic proportions in the fifth and final year. The general increase in the final two years was the leveling factor in what would otherwise have given the feeding village the superior record.

The general sickness rate of the control village for the five years of the study was better than that of the treatment village and equal to the feeding village. It had no epidemic of diarrheal disease, a circumstance only explainable as chance, unless perhaps the somewhat greater isolation of this community and a lesser intrusion of

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strangers incident to the field study itself were the deciding factors.

Three other main qualifications besides the variation in epidemic experience are necessary in interpretation of the results. First, the experimental design restricted measures for medical care and disease prevention to those which could feasibly be accomplished in area villages within the next ten years.

Second, food supplements could be expected to result in an improved nutritional state; and, less likely, the medical and public health program also would have that outcome. Field tests at the beginning and end of the study (Table 1) showed no striking differences among the villages in proportions of children in the several degrees of malnutrition as determined by weight for age.[4] A slight gain was noted among children of the feeding village, the treatment village maintained the status quo, and the control village lost ground slightly. Any observed differences in morbidity and mortality presumably rest on some other basis than clearcut changes in degree of malnutrition, at least as measured crudely by the Gomez classification.[4]

Third, the food supplement taken by individual children varied in amount from less than one fourth of the offered quantities to almost full participation, and it also varied from time to time. Attack rates for the two commonest infections—respiratory disease (as illustrated later) and acute diarrheal disease—followed the same progression: greatest for children receiving less than 25% of added food and more favorable for those having larger amounts. As shown in Table 1 of the preceding report[1] children in the first and second years of life were concentrated in the low-intake group and, as will be demonstrated shortly, children of those ages had the highest attack rates for respiratory and intestinal illnesses irrespective of added food. With correction for age, the incidence of disease is more nearly equal.

Acute Diarrheal Disease

Diarrheal disease is so well established as a dominant feature of health in developing countries[5-7] that the effect of nutritional state on its endemic and epidemic behavior merits detailed attention.[8-10] Interest centers on the weaning process because initial breast feeding is almost universal and the incidence of diarrhea is greatest in children of 6 to 24 months.

The control population illustrated diarrheal disease in its usual endemic behavior for a rural region of the Guatemalan highlands. Its disadvantage as a control was that the five years of observation included no frank epidemic as experienced by the other two communities, an event usual in villages of the region, with about three outbreaks occurring each decade.[11]

Annual Incidence.—Case rates during the study period were regularly twice as great in the treatment village as in either the control or feeding villages (Table 2). Disease incidence in the feeding village during the

Table 1.—*Nutritional State of Children 0-4 Years Old at Start (1959) and Finish (1964) of Observations*

Nutritional State	Santa María Cauqué (Treatment Village) 1959 N	%	1964 N	%	Santa Catarina Barahona (Feeding Village) 1959 N	%	1964 N	%	Santa Cruz Balanyá (Control Village) 1959 N	%	1964 N	%	Total 1959 N	%	1964 N	%
Normal ±9%	24	16.2	28	14.4	9	10.5	19	17.3	29	17.6	15	14.8	62	15.5	62	15.3
First degree malnutrition −10% to −24%*	50	33.8	68	34.9	53	61.6	60	54.5	68	41.2	38	37.6	171	42.9	166	40.9
Second degree malnutrition −25% to −39%*	64	43.2	91	46.7	22	25.6	30	27.3	60	36.4	43	42.6	146	36.6	164	40.4
Third degree malnutrition −40% or more*	10	6.8	8	4.1	2	2.3	1	0.9	8	4.8	5	5.0	20	5.0	14	3.4

* Relative to mean normal weight of well-nourished children.

years when the program was best executed was highly satisfactory. As the proportion of children receiving the offered amounts of dietary supplement declined from 51% in 1960 to 18% in 1964, the attack rate for diarrheal disease increased from 50 to 217 cases per 100 children per year.

All three epidemics were of the long duration characteristic of the region, ordinarily a full year or more. The distinctive incidence in different years and in different villages was mainly a function of epidemics.

Incidence by Age.—Compared with industrial regions, case incidence in the control village was high during the first six months of infancy (Table 3), yet low in comparison with attack rates at later preschool ages in this and other developing areas. It was less by one half than the observed frequency among infants of the same age where the disease was epidemic, such as the treatment village. The rise in rates in the second six months paralleled the increase in general sickness, of which it was a principal element. The active causes were the same: the start of weaning, a deterioration in nutritional state, and a greater opportunity for exposure to infectious disease. By the third semester, 12 through 17 months, the rate had more than doubled to reach a high of 190 cases per 100 children per year. As shown earlier[1] this age marked the usual end of weaning for children of this village. With a consequent better food supply and an increased immunity with age due to repeated infections, the incidence of diarrheal disease began to decline. At age 4 years the attack rate was 103. The behavior is that of endemic diarrheal disease of the region with the traditional medical care of the country and no intercurrent epidemic.

The treatment village was at the other extreme. The community experienced epidemic diarrheal disease on two occasions, and in the interval, a continuing hyperendemicity. Epidemic diarrheal disease had its sharpest effect on infants. The attack rate for those less than 6 months old was twice that of the control, and in those 6 to 12 months of age was close to three times greater. The rates for children in their second year, as usual, exceeded all others. Weaning in this village ended later than in the control, with the result that high diarrheal disease rates were maintained well into the third year. Incidence in the fifth year of life was still 125 cases per 100 children. The age-specific rates were those of a village with epidemic diarrhea. The two outbreaks were little influenced in origin or extent by the program of preventive medi-

Table 2.—*Incidence of Acute Diarrheal Disease by Year for Children 0-4 Years Old*

	Santa María Cauqué (Treatment Village)		Santa Catarina Barahona (Feeding Village)		Santa Cruz Balanyá (Control Village)	
Year Ending April	No. of Cases	Cases/100 Children per Year	No. of Cases	Cases/100 Children per Year	No. of Cases	Cases/100 Children per Year
1960	380	200.0	59	48.0	245	122.5
1961	547	264.2	112	80.0	230	99.6
1962	636	299.1	144	94.7	254	109.5
1963	480	227.5	239	164.8	349	143.6
1964	481	214.7	326	218.8	398	165.1

Table 3.—*Acute Diarrheal Disease by Age in Months, May 1959-April 1964*

		Cases		Deaths	
Age in Months	Population	Number	Cases/100 /Year	Number	Case Fatality Deaths/ 100 Cases
Santa María Cauqué (Treatment Village)					
0-5	138	222	166.8	3	1.4
6-11	111	372	335.1	4	1.1
12-17	111	387	348.7	3	0.8
18-23	109	386	354.1	1	0.3
24-35	206	577	280.1	2	0.4
36-47	196	362	185.2	1	0.3
48-59	174	218	125.3	0	...
Total	1,045	2,524	241.5	14	0.6
Santa Catarina Barahona (Feeding Village)					
0-5	101	78	77.2	2	2.6
6-11	66	146	221.1	3	2.1
12-17	86	167	194.2	1	0.6
18-23	65	131	201.5	0	...
24-35	147	168	114.3	1	0.6
36-47	131	115	87.8	0	...
48-59	113	75	66.4	0	...
Total	709	880	124.1	7	0.8
Santa Cruz Balanyá (Control Village)					
0-5	137	108	78.8	4	3.7
6-11	141	185	131.2	4	2.2
12-17	121	230	190.1	6	2.6
18-23	127	198	155.9	3	1.5
24-35	228	312	136.8	7	2.2
36-47	214	261	122.0	1	0.4
48-59	179	184	102.8	0	...
Total	1,147	1,478	128.9	25	1.7

Table 4.—*Prevalence of Diarrheal Disease by Clinical Type, Children 0-4 Years Old Examined Quarterly, May 1959-April 1962*

Age in Years	Total Children	Without Diarrhea No.	Without Diarrhea %	With Diarrhea: Severe N	Severe %	Moderate N	Moderate %	Mild N	Mild %	Unclassified N	Unclassified %	Total N	Total %
Under 1	867	647	74.6	12	1.4	132	15.2	68	7.8	8	0.9	220	25.9
1	943	690	73.1	17	1.8	135	14.3	92	9.8	9	1.0	253	26.9
2	851	678	79.7	4	0.5	86	10.1	80	9.4	3	0.4	173	20.4
3	782	676	86.4	1	0.1	61	7.8	43	5.5	1	0.1	106	13.5
4	531	459	86.4	3	0.6	38	7.2	28	5.3	3	0.5	72	13.6
Total	3,974	3,150	79.3	37	0.9	452	11.3	311	7.8	24	0.6	824	20.7

cine but did benefit from medical care, as will be demonstrated shortly.

The experience of the feeding village was typical in that it included an epidemic of diarrheal disease. Throughout the study, the food supplement reached older children past two years in more satisfactory amounts than it did children of 6 to 24 months, for whom the need was greatest. These circumstances were paralleled by higher attack rates than in the control village for children less than two years old, and lower rates for older children whose food supplementation was more nearly adequate. The intercurrent epidemic was also an apparent influence, although to a lesser extent than in the treatment village with its series of epidemics; the control had no epidemic. Conceivably, case rates were modified to an extent by better nutrition because under either epidemic (treatment village) or endemic (control village) conditions, rates continued at appreciably high levels among children over 2 years old. With adequate supplemental food intake in the later years, attack rates for diarrheal disease in the feeding village declined to a favorable level for these localities: at age 4 years, 66 cases per 100 children.

Table 5.—*Diarrhea, Seasonal Incidence, 1959-1964*

Month	Cases	Cases/100 Preschool Children/Year
January	339	140.2
February	337	139.3
March	454	187.7
April	368	152.2
May	502	207.6
June	493	203.4
July	475	196.4
August	455	188.2
September	422	174.5
October	387	160.1
November	369	152.5
December	281	116.2

Prevalence of Diarrheal Disease.—Quarterly periodic prevalence surveys of diarrheal disease and of bacterial pathogens in feces were made through April 1962. Examinations in a particular village were within a single day. Cases were based on an existing diarrhea or history of its presence within the preceding week. Carrier rates for *Shigella* among preschool children of the three communities averaged 7.8%; enteropathogenic *Escherichia coli,* 4.2%; and *Salmonella,* 0.1%. The average weekly prevalence of diarrheal disease for all preschool ages was 20.7% (Table 4); it was greatest in the second year of life (26.9%) and it declined to half that value by age 5 years. Diarrheal disease was decidedly frequent, and with additional healthy carriers, the number of foci of infection in the community was impressive. The disease as encountered in prevalence surveys was clinically mild; only about 4% of recognized cases were clinically severe as judged by blood or mucus in the stools. Presumably, the more seriously affected children did not come for examination.

Seasonal Incidence.—The peak month of incidence varied greatly from year to year in the same village and between villages. Sometimes it was as early as March, and in one instance as late as September. The commonest months were June and July. Yet the highest rate for new cases, based on the 4,882 in all three villages during five years, was during May (Table 5), largely because the observed epidemic years tended to center then. The month of May was ordinarily just previous to the rainy season in this area. Case rates continued high until the rains ended in September or October. During the subsequent dry season, monthly incidence was less, although rates remained at a level easily justifying the situation as endemic and even hyperendemic. This seasonal increase developing just before the rainy season and continuing while it lasted is characteristic of many other tropical regions, such as India[12] and Indonesia.[9]

Severity of Infection.—Death rates are one measure of the effectiveness of the programs employed in the three villages, providing allowance be made for small numbers. Necessarily, disease-specific mortality among preschool children for the ten years preceding the study is compared with mortality during the study period because clinical cases upon which to base a case fatality ratio are unknown for the earlier period. According to this comparison, the treatment program produced favorable results. Mortality from diarrheal disease per 1,000 population aged less than 5 years averaged 19.1 deaths per year for the baseline period and 12.4 during the study years.

Case fatality during the study period is also indicative. Diarrheal disease was predominantly epidemic in the treatment village where individual attacks were of longer duration than in the control population; the proportion of cases with blood and mucus in the stools was much the same. Despite the more difficult conditions in the treatment village, case fatality was marginally better than in the feeding village and less than half that in the control village (Table 3). It is significant that (1) the greatest improvement in death rates was among older preschool children, the group where the two experimental programs were best applied; (2) rates in all circumstances were relatively high in the early years of life; and (3) rates in the control village continued high, in contrast with a progressive decline with age in the other two communities.

Severity was classed clinically according to duration of disease in days and the presence or absence of blood and mucus in the stools. Patients with blood or mucus were considered severely infected, irrespective of duration, and cases without that finding were termed moderate if duration was four days or more, or mild if duration was less

Table 6.—*Diarrheal Disease by Days Illness Per Attack, Children 0-4 Years Old, May 1959-April 1964*

	Santa María Cauqué (Treatment Village)		Santa Catarina Barahona (Feeding Village)		Santa Cruz Balanyá (Control Village)	
Duration (Days)	No. of Cases	%	No. of Cases	%	No. of Cases	%
1	17	0.7	13	1.5	2	0.1
2-4	604	24.0	288	32.7	311	21.0
5-6	516	20.4	247	28.1	650	44.0
7-13	801	31.7	239	27.2	486	32.9
14-20	298	11.8	59	6.7	22	1.5
21-27	112	4.4	12	1.4	4	0.3
28-55	143	5.7	20	2.3	2	0.1
56-83	23	0.9	1	0.1	0	...
84-111	5	0.2	1	0.1	1	0.1
112-139	5	0.2	0	...	0	...
Total	2,524	100.0	880	100.0	1,478	100.0

than that. The 2,524 cases in the treatment village included 17.9% severe cases compared with 9.5% of 880 cases in the feeding village and 20.3% of 1,478 cases in the control village. The greatest proportion of mild cases (18.6%) was in the feeding village. Epidemic disease could be expected to include a greater number of severe cases; however, there were fewer in the feeding village despite its epidemic.

Duration in days, as illustrated in Table 6, gives a better view of disability than does clinical evaluation of cases. It also emphasizes the chronic recurrent form of the disease, which is an important feature of transmission, and transmission in turn influences incidence. The few listed cases with duration of a single day strongly support the opinion that diarrheal disease as recorded in this study was of appreciable seriousness.

The belief that the usual attack is brief and explosive, of one or two days duration and ending then, is not substantiated by this experience. About one half of cases lasted three days or less, but close to a third extended into a second week and 15% continued longer than that. Cases of a month's duration were not uncommon, and as many more lasted for two months.

A few scattered cases extended over a still longer period, and in rare instances, for as long as five months. Typically, they were chronic recurrent infections. Acute episodes were interspersed with short periods of fewer stools or even a return to normal numbers, only to be followed by a recurrence of true diarrheal disease. Bacteriological examination of shigellosis of this clinical form showed a usual continuing infection with the same serological type both with and without symptoms, although occasionally true reinfection with a biologically different infectious agent was demonstrated.

These chronic recurrent cases were more frequent in the treatment village where diarrheal disease prevailed so long in epidemic form than in the feeding village where only one epidemic occurred. They were still less frequent in the control village, with no epidemic. The proportions of chronic recurrent cases to all diarrheal disease were 23% in the treatment village, 11% in the feeding village, and 2% in the control. These cases were mainly responsible for the longer average disability in the treatment village—12 days in contrast to eight days in the other two communities.

Duration of illness had little relation to age of the patient; the time tended to be slightly but not significantly longer for infants and for toddlers of the second year than for older children. Differences in incidence between boys and girls were not appreciable.

A separate study in a convalescent home for children[13] heavily seeded with Shigella showed the prevailing serological type to be *Sh sonnei*. This infectious agent also accounted for most of the prolonged recurrent cases. This form of the disease appeared to be the counterpart of the "dangerous nasal carrier"[14] seen in outbreaks of hemolytic streptococcal infection.

Multiple Annual Attacks.—Most preschool children of this region have at least one serious attack of diarrheal disease each year. Of the 2,901 children listed in Table 3, none of those aged less than three years escaped. Multiple attacks were most frequent in the second year, with only one third of the children limited to a single attack—almost an equal number had two, and several had as many as nine. The third year essentially duplicated this experience. Thereafter the frequency was more nearly that of the first year of life.

This particular sort of prospective study gives other evidence on frequency of attacks because of the ability to follow the same group of children through five years with few losses other than by deaths. For the cohort of 48 children born in the treatment village during the first year of the study, annual attack rates per 100 children for the five consecutive years were respectively 248, 464, 268, 160, and 100. The same general progression was seen in the feeding village: 83, 133, 110, 150, and 100. The initial cohort in the control village departed rather definitely from this pattern. Instead of a decline with age, rates were maintained and even increased: 95, 138, 170, 153, and 195. The experience of incomplete cohorts of the four preceding and four subsequent years was of the same general order in each village as the full cohort, with the effect of epidemic years naturally evident at different ages.

Nutritional Disorders

An understanding of the frequency of nutritional diseases and abnormalities, as observed in this study, requires consideration of how the data were collected and what standards were used in defining abnormal nutritional states. Case finding was done in two ways. The most frequent method used was information obtained through home visits by trained but non-medical female field workers. They listed acute manifest diseases recognized by themselves or by mothers or other attendants. Because of the insidious onset and slow evolution of malnutrition, their listings did not include mild forms of it or of other chronic diseases in their early stages. These were not recorded until they became clinically obvious to lay persons.

Nutritional diseases included kwashiorkor, marasmus, and the common avitaminoses. Field workers were fully instructed in the usual signs and symptoms, and urged to report even suspected cases. However, the numbers identified were so few as to be lost in the general category of other diseases.

Of necessity, less advanced manifestations of protein-calorie malnutrition were identified by other clinical means: primarily by a faltering in expected growth and development evidenced either by deficits in weight or height for age, or by a change in growth rate. These were clinically inapparent, yet the most widespread consequence of inadequate nutrition. Thus the paradox arises that malnutrition and infection are both highly prevalent among populations of developing countries studied over a sufficient period of time, and yet malnutrition does not often appear as a direct cause of disability. For these reasons, malnutrition is considered independently in a later report of this series concerned with retardation of growth and development.

The second method of case finding of nutritional disease in the child population was a series of clinical examinations by a physician at intervals of three months during the first year of study, and every six months during the second and third years.[15] Positive findings suggestive of malnutrition were close to negligible in all three villages, and the examinations were ended after three years, primarily because they were unproductive. This was not a result of screening out cases in the treatment village as they occurred or of their failure to develop in the feeding village; no more were found in the control population.

Kwashiorkor.—Kwashiorkor is easily the most important among clinically manifest nutritional diseases of the tropics. As one syndrome of protein-calorie deficiency[16] it occurs most frequently among children in the second and third years of life under conditions where deficiency of protein is more marked than deficiency of calories. It is not so universally recognized that kwashiorkor is an acute illness superimposed on a far more frequent condition, chronic protein-calorie malnutrition, which in many regions affects as many as three fourths of young children. From minor deficiencies to the serious deprivation of kwashiorkor, the continuum is the significant feature of a general complex responsible for a broad effect on health and on the growth and development of young children.

During the five years of the study, 14 children died of kwashiorkor—five in the treatment village, four in the feeding village, and five in the control community. The differences in frequency of deaths were inconsequential. Of the five deaths in the treatment village, all were under medical management, although only late in the course of the disease. In the feeding village one child had participated in the program initially and to a satisfactory extent, but had discontinued long before the disease developed. Two others took part to a minor degree, one of them having 7% or less of the offered amounts of dietary supplement. The fourth received no supplement. Comparison of feeding and control villages is vitiated by the understandable action of field staffs of both villages in referring and even taking severely affected children to a hospital, which probably saved a number of lives.

The recognition by field workers of cases of kwashiorkor, both fatal and non-fatal, was not always accurate. Some were reported as acute diarrheal disease because of the regularity with which that condition precipitates kwashiorkor and the usual presence of diarrhea as a sign of kwashiorkor itself. Sometimes, indeed, the two were a single continuous event. In several instances subsequent medical review identified kwashiorkor from recorded signs of edema, hair changes, skin manifestations, and other clinical evidence.

Perhaps the best estimate of cases of kwashiorkor is to be had from the proportion of children with a weight deficit or age of 40% or more, a level consistent with either kwashiorkor or marasmus. Marasmus was not identified in this study. Data on weight by individual villages and by host characteristics will be presented in a succeeding paper. The general average of third degree malnutrition for children less than 5 years old was five cases per 100, with a concentration in the second and third years of life, and no significant differences among villages.

As shown earlier,[17] general death rates in the three villages were regularly less during the study than in the preceding ten years. Without direct evidence, this probably included kwashiorkor among other causes, since kwashiorkor was less frequent during this time than in the preceding decade. Since the decline was common to all three villages, it could not be attributed specifically to medical care in one village or to the dietary supplement in the second. However, the record in the study villages is not a good indicator of present conditions in the general area because as many kwashiorkor patients are being admitted to Guatemalan hospitals as in previous years. With the increasing size of populations and the falling per capita production of food so characteristic of most Latin American countries today, the prospect of a lesser frequency of kwashiorkor is remote, even with improved medical services.

Marasmus.—Nutritional marasmus is primarily a caloric deficiency and is incident to premature weaning. Since almost all children of this area are breast-fed, commonly for more than two years, nutritional marasmus is extremely rare; no case was observed during the five-year study.

Interaction of Infectious Disease and Malnutrition.—The regularity with which kwashiorkor is preceded by an acute infectious disease in children of depleted nutritional state is so well established that it is a recognized part of the clinical pattern of the disease. Acute diarrheal disease was the commonest precipitating cause in this study, although a variety of other acute infectious diseases had a similar effect, including measles, chickenpox, whooping cough, and numerous nonspecific infections.

The nutritional state of the host commonly had a strong influence on the severity of these infections in the study villages and, for some of the infections, on frequency as well. The high fatality of measles[18] and the frequency of complications in chickenpox[19] were directly proportional to a poorer nutritional state. This was equally true of diarrheal disease; the evidence was less precise for acute respiratory infections. So widely does this relationship hold that the characteristics of severity and incidence are commonly attributed to weight deficiency of the host, which in turn is one criterion of malnutrition. Much weight deficiency is truly malnutrition, but perhaps even more is secondary to the nutritional consequences of infectious disease.

Malnutrition and Undernutrition.—The criterion for malnutrition used in this study was a prescribed deviation below an accepted reference standard of weight for age. The classification was that of first, second, and third degree malnutrition, based respectively on weight deficiencies of 10%, 25%, and 40% or more.[20] Third degree malnutrition generally corresponds to clinical malnutrition identifiable as marasmus or kwashiorkor, which also may be evident in second degree malnutrition. In some other circumstances, body weight is less than the established norm for well nourished children of the particular age, although appropriate to the child's height. While this suggests undernutrition in the sense of a departure from the standard, it is due to inadequate growth at a previous age rather than at the time of measurement. Measuring weight in relation to present height consequently has more value for older preschool children.

To properly differentiate malnutrition from simple undernutrition, more account must be taken of weight variation associated with recognized pathologic changes. A number of leads to the accomplishment of this purpose arise from this study. They are the relationship of bone maturation to weight deficiency, and the extent to which fat accounts for observed weight when lean body mass is inadequate. Biochemical measurements are, in theory, another means of differentiation, but none has been demonstrated as practical, with the exception of the ratio of height to 24-hour urinary creatinine.

A procedure little explored is to judge weight for age, not by periodic measurements at prescribed times, but by increments at specified intervals—incidence as contrasted to prevalence in epidemiological terms—with due regard for intervening pathologic events such as disease and injury by number of episodes, their duration, and their aggregation. Mental age may also possibly be correlated positively with early malnutrition and retarded physical development.[21]

Respiratory Tract Diseases

The illnesses within this class ranged from simple upper respiratory infections, predominantly common colds, to deep-seated infections, mainly pneumonias and tuberculosis. As with acute diarrheal disease, the information was collected by non-medical home visitors and was without medical confirmation except when patients visited the clinic in the village where medical care was provided, though a physician reviewed field workers' reports to eliminate obvious errors. Recorded illnesses were again those of children more seriously affected and of a nature recognized by the parent or lay investigator.

Annual Incidence.—Incidence from one year to another departed only moderately from established averages for the study as a whole. All three villages had higher rates than usual in 1964: the feeding village exceeded any other in any year, 183 cases per 100 children. The excess incidence usually developed seasonally, although in that year the increase began in May, which is early. The peak occurred in July, but there was no sharp rise and decline within a month or two. Instead, an increased incidence was evident in all months. Other years of moderate excess incidence were 1962 in the treatment village and 1963 in the control community. None of the outbreaks suggested influenza.

The feeding village had an especially good record for respiratory disease during the first three years when the feeding program was functioning well. As participation decreased in the final two years, both respiratory and diarrheal illnesses showed increased incidence. Numbers of cases of both were seemingly related to the extent that children participated in the supplemental feeding. Table 7 shows the highest attack rates among children receiving no food supplement or only token amounts (less than 25% of food offered). The most favorable rates, 54 cases per 100 children per year, were among those participating 75% or more. As already noted, the children who received the smaller food supplements were chiefly less than 2 years old. Children of these ages normally have the highest rates for simple upper respiratory disease, as will be demonstrated shortly. With correction for these two factors, differences in disease incidence according to amount of supplement are less impressive.

Table 7.—*Respiratory Disease in Preschool Children of Feeding Village by Percent Participation in Food Supplementation, May 1959-April 1964*

Percent Participation in Dietary Supplementation	Respiratory Diseases: No. of Cases	Respiratory Diseases: Cases/100 Children/Year
0-24	208	107.3
25-49	94	65.4
50-74	69	65.1
75+	143	54.1

Case Incidence.—Deaths attributed to respiratory diseases among preschool children in the villages did not exceed those from diarrheal disease by more than an inconsequential margin. However, the case rate for all respiratory disease, as determined by home visits, was measurably less than that for diarrheal disease: an average 86 cases per 100 preschool children per year (Table 8) as compared with a case rate for diarrheal disease of 242 in the treatment village, 125 in the feeding village, and 129 in the control. This appears to represent only the more severe attacks, since expectancy for common colds is about 2.5 attacks per year, and for these younger ages is even greater.[22]

The three villages each had rates for respiratory disease in the same proportion as rates for diarrheal disease and also as rates for all illnesses. The village with medical services had the highest case incidence and the control village about half that rate, while the feeding population was in an intermediate position with a rate of 73 cases per 100 children under five years of age.

Table 8.—*Incidence of Infectious Respiratory Diseases by Village and by Age, May 1959-April 1964*

	Santa María Cauqué (Treatment Village)			Santa Catarina Barahona (Feeding Village)			Santa Cruz Balanyá (Control Village)			Three Villages		
Age	Cases	Population	Cases/100/Year	Cases	Population	Cases/100/Year	Cases	Population	Cases/100/Year	Cases	Population	Cases/100/Year
−1	483	247	195.5	195	167	116.8	181	277	65.3	860	691	124.5
1	334	218	153.2	138	153	90.2	148	246	60.2	620	617	100.5
2	244	205	119.0	91	144	63.2	123	227	54.2	458	576	79.5
3	172	196	87.8	60	129	46.5	107	200	53.5	339	525	64.6
4	99	179	55.3	30	111	27.0	67	178	37.6	196	468	41.9
Total	1,332	1,045	127.5	514	704	73.0	626	1,128	55.5	2,472	2,877	85.9

Table 9.—*Incidence of Common Communicable Childhood Diseases, All Forms, Three Villages, by Age at Attack*

Age in Years	Population	Cases	Cases/100 Persons/Year
−1	694	65	9.4
1	619	95	15.4
2	581	91	15.7
3	541	72	13.3
4	466	64	13.7

Age-Specific Incidence.—The incidence of respiratory disease was greatest during the first year of life (Table 8) in all three villages and in all five years. In regular progression, case rates declined with advancing age to reach an average 42 cases per 100 children between 4 and 5 years old, though disease and injury of all forms were most common in the second year.[1]

Seasonal Incidence.—Guatemala is about 15° north of the equator, and therefore has only a rainy and a dry season. The rainy season in the highlands (June to September) is damp and cool and commonly called winter. This is the time of respiratory infections, July and August being the usual peak months although an incidence beyond the annual average continues to a lesser degree after the rains cease.

It is noteworthy that the seasonal prevalence of diarrheal disease and of respiratory infections more or less coincide. In addition, observation of patients showed a frequent clinical association of respiratory and intestinal symptoms. This combination was also noted in long-term prospective studies of family illnesses in an urban population of the northern United States, although there the seasonal prevalence of respiratory infections is in winter and of intestinal infections is in summer.[22] A possibly greater frequency of associated symptoms in patients of a tropical region where the two diseases occur in the same season is worth investigation.

Duration of Respiratory Illness.—The main purpose for collecting information on duration of illness was to determine its effect on growth and development. The concern was with number of illnesses, number of days ill, and intervals between episodes. About one third of all respiratory illnesses in the study as a whole had a duration of less than one week. Essentially another half ended within the second week, and a further sixth within the third week.

Respiratory illness of a month or more was most frequent in the treatment village, approximating 6% of the total; in the other two villages the proportion was about 2%. This suggests that pneumonias and childhood tuberculosis were more common in the treatment village. Case fatality of respiratory disease, however, was less by one half in the treatment and feeding villages (1.2% and 1.7%, respectively) than in the control (4%). This difference also held for mortality: 15.4 per 1,000 preschool children at risk in the treatment village and 12.8 in the feeding village, in contrast to 23 in the control. Due to the few deaths, the results are no more than suggestive. However, the comparability between case fatality of respiratory disease and mortality suggests that case finding and report of disease were of equal quality in the three villages.

Communicable Childhood Diseases

The ordinary specific communicable diseases of childhood—measles, whooping cough, chickenpox, mumps, and rubella—made a significant contribution to general disease incidence. Scarlet fever, diphtheria, and the meningitides were of irregular and minor occurrence. In this study, case fatality was high for measles,[23] 6.8% in one outbreak. In recent years measles mortality for all ages in Guatemala as a whole has been about 250 times that in the United States.[23]

The early age of attack was clearly important in determining fatality from these diseases. Table 9 gives attack rates by age for the five diseases as a group in the three villages. Individual communities showed few differences. Incidence in the first year of life was relatively great, but was highest in the second and third years. Measles[23] and chickenpox[19] occurred as epidemic diseases. Because of immunization, whooping cough was less frequent and cases were scattered. Cases of mumps and rubella were few.

As expected, nutritional state had relatively little to do with attack rates. It had, however, a distinct relation to frequency of complications. Acute diarrhea as a complication occurred in direct proportion to deficiencies in weight for age.[23] Kwashiorkor was precipitated among the more seriously malnourished by even as mild an infectious disease as chickenpox.

Injuries

A first impression of almost any village population in a developing region is the excessive number of cripples, only some of whom were crippled by disease. That accidents are the first cause of death among developing populations in a rigorous environment such as Alaska or Greenland is no surprise.[24] In the United States, after the first year of life, accidental injury is the first cause of death for all age groups 1 to 4 years through 25 to 44 years.[25]

In tropical regions, deaths from injuries are greatly overshadowed in numbers by those from infectious disease and malnutrition. In the few studies made, absolute death rates per 1,000 preschool children match those of industrial countries, and accidents rank well down the list of leading causes of death. Deaths by accident were negligible in the present study, and attention was limited to serious accidents with a duration greater than one week. The general incidence was 14 such injuries per year per 1,000 children aged less than five years.

In studies in a rural area of the Punjab, India,[26] accidents of this duration accounted for about 15% of disabling injuries at these ages. Using this factor, total disabling accidents for the present preschool population would be 90 per 1,000 per year compared with the Indian rate of 116.

Within limits of small numbers, the experience with serious accidents was much the same in all three villages, with rates of 11 per 1,000 preschool children in the treatment village, 16 in the feeding village, and 11 in the control. Disability from these accidental injuries averaged 15 days.

The results indicate a frequency of disability from accidental injuries in rural tropical regions approximating that in temperate and cold climates. Even with the high incidence of infectious and other diseases, accidental injuries are sufficiently frequent to place them among public health problems. Their relation to nutritional state and to physical and mental development was unexplored.

Parasitic Diseases

Parasitic diseases received little emphasis in the morbidity records of this five-year study.

No systemic parasitic infections were seen among preschool children. The three villages are in a highland area where malaria had been fully controlled before the study began. Although onchocerciasis is common in a nearby area, it was not identified in the study villages.

A survey for frequency of intestinal parasites was made in the three villages at the time the study started.[15] The total prevalence of one or more species among children less than 5 years old was 62%, with no essential differences among the three populations. Almost one half of the children had more than one species and a few had five or more. As the study progressed, surveys were made at intervals of six months during three years. Rates continued essentially unaltered in all villages.

The control village would not be expected to change materially. Moreover, little theoretical basis exists for expecting a lower frequency of intestinal parasitism from better diet alone with environmental sanitation remaining unchanged, and there was none. A modified prevalence could have been anticipated in the treatment village; two procedures were considered for treatment: mass treatment of all children and improving the sanitary conditions. Reliance was placed on the second, since treating all children with parasites by mass measures alone would have given an immediate result, only to send them home to be re-infected. Reduced transmission and consequent lesser incidence depends on sanitary measures. To have employed both procedures would have given a better result, but would have left unknown the accomplishment possible from environmental sanitation alone, which is the main reliance in developing countries and most others. Consequently, only clinical indications determined treatment for parasites. Indications were few, and usually related to other conditions than specific intestinal parasitism.

There was minimal success with sanitary measures applied in the treatment village, either in controlling general disease incidence or in improving parasite rates for children. The general parasite rate was unchanged after three years. Individual frequencies remained closely similar to those reported earlier.[15]

Periodic prevalence determinations gave useful information about ages at which infection occurred. By 6 months 21% of children harbored at least one intestinal parasite. The rate increased progressively with age to reach 89% in children between 4 and 5 years old, with highest values for *Ascaris* and *Trichuris*. Infections with *Entamoeba histolytica* and other amebae were fewer and the increase less rapid. *Giardia lamblia* behaved differently; invasion was prompt at early ages and peak prevalence was at ages 2 to 4 years, with a decline in new infections in later years. Within narrow limits, general prevalence rates of parasites rose regularly although minimally during January and again in the rainy season, from August to October.

Ascaris and *Trichuris* commonly produced no readily identifiable symptoms, although severe infections with Ascaris organisms are known to interfere with intestinal absorption,[27] and massive fatal infections in young children have been described.[28] Egg counts of helminth species were not made.

A few cases of acute diarrheal disease during the study period were attributed to intestinal protozoa. However, among all identified infectious agents, their number was inconsequential; and since most diarrheal disease was of unknown cause, the number among total cases was negligible.

In a prevalence study of diarrheal disease in ten Guatemalan villages, in both highland and lowland areas,[29] parasites including *E histolytica* and *G lamblia* were no more frequent in patients with diarrhea than in those without. By prevalence surveys, *E histolytica* was somewhat more common in the feeding village (12%) than in either the treatment or the control villages (7%), although, again, no differences existed between patients with and without diarrheal disease.

Comment

The present discussion concerns the frequency of disease and injury observed in three Guatemalan villages under different programs of management. Physical growth and development will be considered subsequently.

The extent of morbidity in populations of developing regions is little known. The values are none too well determined in regions where good conditions prevail. An evaluation of present results requires understanding of the nature of case finding, the quality of the collected data, and the limits these two factors impose on interpretation. Case finding was by trained, non-medical female field workers who had more education than the mothers and had been instructed in selected disease conditions. However, these workers depended for information primarily on the mothers, who were commonly illiterate and enured to acceptance of disease and nutritional deficiency as a way of life. The fortnightly home visits were sufficiently frequent to favor rememberance of most minor events, yet the results strongly indicate that disease and injury had to be relatively severe to be recorded.

These field records were reviewed by a physician, whose interpretations were by clinical judgment, unassisted by physical examination, laboratory aids, or hospital study of obscure illnesses. No physician saw patients other than in the treatment village. As in the other two villages, field results were recorded solely by the female field workers and excluded observations in the clinic. Inevitably, however, the physician's interpretation was somewhat biased by his personal knowledge of some patients. For the stated reasons, classification of illnesses was by the simple scheme noted. Attempted extrapolation to more specific diagnoses, for example of respiratory infections, would have been unjustified.

Possible bias in case finding was introduced by the presence in one village of a medical clinic to which children could be taken. Transmission of infectious agents may have been favored by bringing sick children together there. The greater intimacy between residents and field workers engendered by daily contact at the feeding center likely promoted case finding in that village, while the fewer staff members, lesser personal contact with the people, and absence of direct benefit from the report of illnesses probably had an inhibiting effect in the control village. The data from the three villages are believed to be generally comparable, however, and to serve the intended purpose of determining to what extent individual programs of management influenced morbidity.

Summary

Acute diarrheal disease was the commonest illness among rural preschool children of Guatemalan villages. The addition in one village of services for medical care, disease prevention, and improved environmental sanitation, to the extent provided, and more importantly, to the degree accepted by the people, did not inhibit occurrence of two long-term epidemics. Incidence of diarrheal disease was greater than in either the village with dietary supplementation or the control village with no medical service or added diet.

Mortality from diarrheal disease in the treatment village was less than in a preceding nine-year baseline experience; case fatality during the study equalled that of the feeding village and was measurably better than that in the control population. The population of children receiving the dietary supplement had lower attack rates than the treatment village, but about the same rates as the control.

As judged by fewer deaths and shorter average duration of illness, acute diarrheal disease was favorably influenced by added diet. Epidemic diarrheal disease, which occurred in both test villages, was associated with much chronic recurrent diarrheal disease, a clinical form generally absent in the control, which had no epidemic.

Respiratory diseases of all forms had an incidence in all three villages about one half that for diarrheal disease, although deaths from the two conditions were essentially equal. The common communicable diseases of childhood were equally prevalent in the three villages; case fatality and complications were proportional to a poor nutritional state of patients.

By the methods employed, specific nutritional diseases and general malnutrition entered uncommonly into records of illness because of their insidious onset and slow evolution. Injuries, on the basis of sketchy evidence, had an incidence comparable to that in advanced countries, their importance obscured by the high morbidity and mortality from other causes.

For all major disease classes, case incidence among preschool children reached its peak in the second year of life coincident with weaning from breast feeding and the severest nutritional deficiency.

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SOCIAL NONSMOKING

Several reasons may be advanced for the apparently limited effectiveness of educational campaigns. The incidence of lung cancer is small and therefore the individual smoker finds it easy to believe that he will not be stricken. Among smokers there is wide acceptance of the belief that it is very difficult to give up smoking. Can one expect high school students to be influenced by the possible threat of disease or disability 20 or 25 years in the future? All of these attitudes apparently are markedly resistant to change. In the light of these considerations it is not difficult to account for the limited effectiveness of educational campaigns which are essentially attempts to change such attitudes.

How then does one affect the smoking habits of the large majority of smokers, who seem to be convinced that not only is it very difficult to stop smoking, but that smoking will not harm them personally? While smokers seem unwilling or unable to restrain themselves from smoking for health reasons, they may be willing and able to alter their smoking habits for social reasons. For example, if somehow it came to pass that one didn't smoke on the job regardless of whether one is a white-collar or a blue-collar worker, or whether one is at the executive or at a subordinate level, then obviously the amount of smoking would be markedly reduced. Or, if the arbiters of good taste were to rule that smoking in a dining room and smoking in public were in bad taste, the amount of smoking would be reduced. The findings of a recent study suggest that the general public may be quite prepared to accept such changes in prescribed appropriateness in particular social situations. It appears then that it may be more effective to ask people to change their smoking behavior in response to modified social conventions than to seek to induce people to stop smoking by attempting to alter their beliefs about smoking.—Weitman, M., and Spence, S. M.: Smoking Patterns and Specialty Training of Oregon Physicians *Cancer* 20:974-982 (June) 1967.