# Original Articles

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

## II. Field Reconnaissance, Administrative and Technical; Study Area; Population Characteristics; and Organization for Field Activities

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THE Institute of Nutrition of Central America and Panama (INCAP) since 1949 has studied the nutritional problems of Central America and has advised public health authorities on programs for the control of nutritional and allied diseases. From the beginning, field study has been an integral part of the institute program. The present epidemiological investigation was conducted in Guatemala.

The first step in any field study is to assure the support and cooperation of governmental authorities in the region where the work is to be done, especially those responsible for the public health. After decision on objectives and study plan,[1] field reconnaissance determines the practicability of operations in what is judged a suitable area.

### Field Reconnaissance

Preliminary survey of the situation included administrative aspects and technical features. That procedure has special importance in operations in a foreign country[2]; it is essential in domestic activities, as in this instance.

**Administrative Aspects.**—The first obligation, to obtain authorization and enlist understanding by the government, was for this study little more than a matter of form. The central Guatemalan government, through INCAP, was itself the sponsoring agency; furthermore, from preceding associations, health officials were fully conversant with field studies and sympathetic with their aims. Regional officials also were well aware of the function and activities of INCAP, as were many from the nearby villages and towns.

*Cooperation of the Study Population.*—While no study is possible without the interest and cooperation of government, productive field work requires, even more, an assurance that the people of the study population are willing to take part, that they have a sympathy and understanding of what is proposed, and that there is prospect of mutual benefit. Certainty in these matters may take weeks or months of living and working with the people and demands more than an amateur competence in social anthropology. In this instance the groundwork had been laid. Several years of field work in a variety of projects which included features of the present investigation ensured that village populations of the Guatemalan highlands were suited to the study and friendly to what was proposed.[3]

*Migration.*—A stable population favors long-term epidemiological investigations. Accumulated experience in this same region had demonstrated that little emigration or immigration occurred; indeed, less migration to cities than might be expected under present day conditions, and so little as to be close to negligible. An inconsequential fea-

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**Table 1.—*Ten Leading Causes of Death Reported in Guatemala, 1959*[11]**

| Abbreviated Code | Deaths | Deaths/100,000 Population/Year | Cause of Death |
|---|---|---|---|
| B 17 | 9,313 | 255 | All other diseases classified as infective and parasitic |
| B 45 | 8,776 | 240.3 | Senility without mention of psychosis, ill-defined or unknown causes |
| B 36 | 8,518 | 233.3 | Gastritis, duodenitis, enteritis and colitis, except diarrhea of the newborn |
| B 31 | 4,250 | 116.4 | Pneumonia |
| B 9 | 4,068 | 111.4 | Whooping cough |
| B 46 | 3,808 | 104.3 | All other diseases (residual) |
| B 30 | 3,615 | 99 | Influenza |
| B 44 | 3,409 | 93.4 | Other diseases peculiar to early infancy and immaturity, unqualified |
| B 43 | 3,009 | 82.4 | Infection of the newborn |
| B 14 | 1,379 | 37.8 | Measles |
| Total | 63,010 | 1,725.5 | All Causes |

ture was a seasonal move by some employable householders to lowland regions of Guatemala for work on sugar cane and cotton plantations. Ordinarily this was short term, for a month or two. While whole families occasionally went, preschool children with whom this study was concerned usually remained in the village.

*Access to Study Area.*—A reasonable proximity to the base of operations in Guatemala City, sufficient distance to give semi-isolation, and a ready means of transport were significant administrative considerations. Travel expense and prompt provision of supplies and equipment were other factors. Staff convenience and staff morale, however, were foremost. Five years is a long time to work in a rural village. Field workers, if they are to know the population, must live there, because periodic visits from the city are not productive of the best results. Opportunity, therefore, has to be provided the resident staff for weekends and other leave at the base; part-time professional workers should not spend more time traveling than working; and ready availability of consultants on special occasions is a necessity.

In the rural Guatemalan highlands, farmers live in villages rather than on the land they cultivate. The result is a plentiful supply of small semi-isolated communities of 200 to 2,000 people within 50 kilometers of the Institute in Guatemala City. Roads are better than in most rural areas of developing countries, and motor transport is wholly feasible. The compact nature of the villages eliminated the need for local transport; travel by foot from house to house was practical. As a consequence, transport afforded less than usual difficulties.

*Existing Field Studies.*—The study design[1] called for populations living under natural conditions with no extraneous factors intentionally introduced except for the two prescribed programs. Two other field studies were underway in the general area, both under the auspices of INCAP, and therefore well known. Preliminary survey demonstrated that village populations existed of appropriate size and sufficiently distant from these on-going investigations to be unaffected by them. On the other hand, these studies would contribute information directly and indirectly useful to the present activity, as had those of previous years.

**Technical Features.**—The main technical concern of this survey of the area was the existing prevalence of infectious and nutritional diseases. A knowledge of rates of occurrence had direct value in determining the suitability of the region to the investigation. With allowance for epidemic variations, the frequency of occurrence was the chief reliance in deciding the size of population needed and the time observations should last.

*Disease Prevalence.*—The two commonest infectious diseases of the region were the syndromes of acute diarrheal disease and infections of the upper respiratory tract. Earlier INCAP experience[4] had given reliable values for diarrheal disease among rural children. Incidence ranged from 180 to as much as 400 cases per year per 100 children less than 5 years old, or an annual average of better than two attacks per child. Deaths

from diarrheal disease, also determined by field survey, had averaged in recent years 20.5 per 1,000 preschool children.

Factual information on respiratory diseases was not available but field experience suggested a higher incidence and a more severe disease than in industrialized countries. The specific common communicable diseases of childhood, such as measles and whooping cough, also had an exaggerated severity as judged by the number of deaths.

The more extensive studies on nutritional disorders had demonstrated their high incidence[5] and their contribution to total deaths in childhood populations.[6] Mean weights of preschool village children according to age were less than the 16th percentile of the standard for a well-nourished population.[7] Kwashiorkor had been established as a common and severe nutritional deficiency disease.[8]

*Death Rates by Cause.*—The first ten leading causes of death as officially reported in Guatemala in 1959, all ages, are presented in Table 1. In first place was "All other diseases classified as infective and parasitic" aside from the 16 listed individually in the International Lists of Diseases and Causes of Death of the World Health Organization.[9] Except for diseases of unknown nature, the group recognized as acute diarrheal disease was next. In all, the first ten causes included seven infectious diseases, clearly establishing the important place they occupy in developing countries compared to advanced regions with good health services. In the United States, for example, only one infectious disease, pneumonia, was represented in a similar list, and the crude death rate was 9.4 per 1,000 population per year. In Guatemala it was 17.3.

*Public Health and Medical Services.*—None of the highland Guatemalan villages surveyed had a local physician although a few were visited at intervals by a physician from the national public health department. Medical care was provided by practitioners of folk medicine and obstetrical service was by midwives of the village, who were usually untrained and often illiterate. Clinic and hospital facilities were available only in Guatemala City and the capitals, Antigua and Chimaltenango, of the two departments in which the villages were located. Transport difficulties restricted use of these facilities.

The national ministry of health gave some aid to rural populations in environmental sanitation, in the improvement of water supplies and promotion of nutrition. Decentralized health services existed in departmental capitals and in larger urban centers but did not extend to rural regions. No village had an organized agency for public health, either lay or professional.

The epidemiological behavior of infectious diseases and their effect on a community are strongly influenced these days by the extent to which antibiotics and sulfonamides are in use. These drugs were little employed in the villages. They were stocked in small amounts in village shops and by the local pharmacist where there was one. They were sold to the public on demand and had some use by the practitioners of folk medicine who provided most of the local medical service.

**Summary of Reconnaissance.**—Preliminary survey of the area and its people indicated conditions favorable to the projected study. Infectious disease was unduly frequent. The greater part of the preschool population was malnourished, and kwashiorkor or severe protein-calorie deficiency disease was a significant cause of death.

More than usually satisfying data on the general area were obtained within a single month of field survey during December 1958. This was possible because of information available from preceding field studies and other collected data at INCAP headquarters. The time ordinarily is much longer. The study then moved into its organizational phase.

## Field Organization

A fundamental feature of the study plan

**Table 2.—*Populations of the Study Villages, Guatemala, by Age, May 1959***

| Age (Years) | Santa María Cauqué | Santa Catarina Barahona | Santa Cruz Balanyá |
|---|---|---|---|
| 0-4 | 192 | 108 | 221 |
| <1 | 39 | 34 | 51 |
| 1 | 45 | 22 | 45 |
| 2 | 33 | 17 | 41 |
| 3 | 47 | 19 | 39 |
| 4 | 28 | 16 | 45 |
| 5-14 | 258 | 191 | 366 |
| 15-34 | 262 | 232 | 430 |
| 35-64 | 197 | 204 | 306 |
| 65+ | 14 | 18 | 40 |
| Total | 923 | 753 | 1363 |

**Table 3.—*Population Characteristics of the Study Villages, 1959***

| | Santa María Cauqué | | Santa Catarina Barahona | | Santa Cruz Balanyá | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Race | | | | | | |
| Ladino | 36 | 3.9 | 14 | 1.9 | 81 | 5.9 |
| Indian | 887 | 96.1 | 739 | 98.1 | 1,282 | 94 |
| Economic status (families) | | | | | | |
| Better | 10 | 5.4 | 2 | 1.1 | 27 | 9.2 |
| Usual | 132 | 71 | 99 | 52.4 | 92 | 31.2 |
| Poor | 44 | 23.7 | 88 | 46.6 | 176 | 59.7 |
| Home owner (families) | | | | | | |
| Own home | 159 | 85.5 | 161 | 85.2 | 267 | 90.5 |
| Rent or other | 27 | 14.5 | 28 | 14.8 | 28 | 9.5 |
| Total homes | 186 | | 189 | | 295 | |

as previously presented[1] was a division of the total study population into three parts, each a single village community. Children under 5 years of age in one village were to have a food supplement; those of a second village an integrated health service excluding nutritional measures but including clinical care of sick persons. A third village was a control. Death and disease incidence from all causes among preschool children were to be determined in the three villages during 5 years, along with measurements of concurrent nutritional state and of physical growth and development.

**Table 4.—*Living Accomodations and Environmental Conditions in Study Villages, by Families, 1959***

| | Santa María Cauqué | | Santa Catarina Barahona | | Santa Cruz Balanyá | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Type of Dwelling | 186 | | 189 | | 295 | |
| Better (class A) | 33 | 17.7 | 18 | 9.5 | 22 | 7.5 |
| Usual (class B) | 123 | 66.1 | 135 | 71.4 | 91 | 30.85 |
| Poor (class C) | 30 | 16.1 | 36 | 19.1 | 182 | 61.7 |
| Kitchen | | | | | | |
| Present | 22 | 11.8 | 69 | 36.5 | 108 | 36.6 |
| None | 164 | 88.2 | 120 | 63.5 | 187 | 63.4 |
| Stove | | | | | | |
| Present | 8 | 4.3 | 11 | 5.8 | 34 | 11.5 |
| None | 178 | 95.7 | 178 | 94.2 | 261 | 88.8 |
| Water source | | | | | | |
| Public | 171 | 91.9 | 182 | 96.3 | 264 | 89.5 |
| Private | 15 | 8.1 | 7 | 3.7 | 31 | 10.5 |
| Close* | 180 | 96.8 | 189 | 100 | 59 | 20 |
| Remote | 6 | 3.2 | | 0 | 236 | 80 |
| Toilet Facilities | | | | | | |
| Flush Toilet | 4 | 2.2 | 3 | 1.6 | 0 | ... |
| Latrine | 135 | 72.6 | 34 | 18 | 41 | 13.9 |
| None | 47 | 25.3 | 152 | 80.4 | 254 | 86.1 |
| Garbage and Waste | | | | | | |
| Burn | 13 | 7 | 3 | 1.6 | 2 | 0.7 |
| Bury | 38 | 20.4 | 19 | 10.1 | 0 | ... |
| Fertilizer | 131 | 70.4 | 163 | 86.2 | 292 | 99 |
| Discard | 0 | ... | 4 | 2.1 | 0 | ... |
| Unknown | 4 | 2.2 | 6 | 3.2 | 1 | 0.3 |

* Within 200 m.

**The Study Area.**—Since the Institute of Nutrition in Guatemala City was the base for field operations, the study area was restricted to villages within a radius of 50 kilometers, less than an hour by motor car, for the main roads are paved. Secondary dirt roads are improved and usable in all weather; some few villages are accessible only by unimproved roads or trails, ordinarily passable by car but difficult in the rainy season.

Guatemala has a variety of terrain ranging from the central mountainous highlands with a delightful temperate climate to coastal, essentially tropical areas on both Atlantic and Pacific Oceans. The study area as selected was wholly within the highlands, at elevations of about 2,200 meters (Fig 1). The main concentration of population is in the highlands.

The country has two main seasons, a dry season from about October to the following April and a wet season from May through September. Rain is most uncommon during the dry season; during the wet season it may be expected almost daily, and yet wholly rainy days are unusual. Annual rainfall in the highlands is about 120 cm. Temperatures for the year average 18 C with 16 C in December and 21 C in May, but for the most part so regular at about 20 C that Guatemala is often characterized as the land of eternal spring.

**Study Population.**—On the basis of earlier exploratory field studies on incidence of disease and deaths, and with the proportion of children aged less than 5 years determined at about 16% of the general population, the requirement for statistically reli-

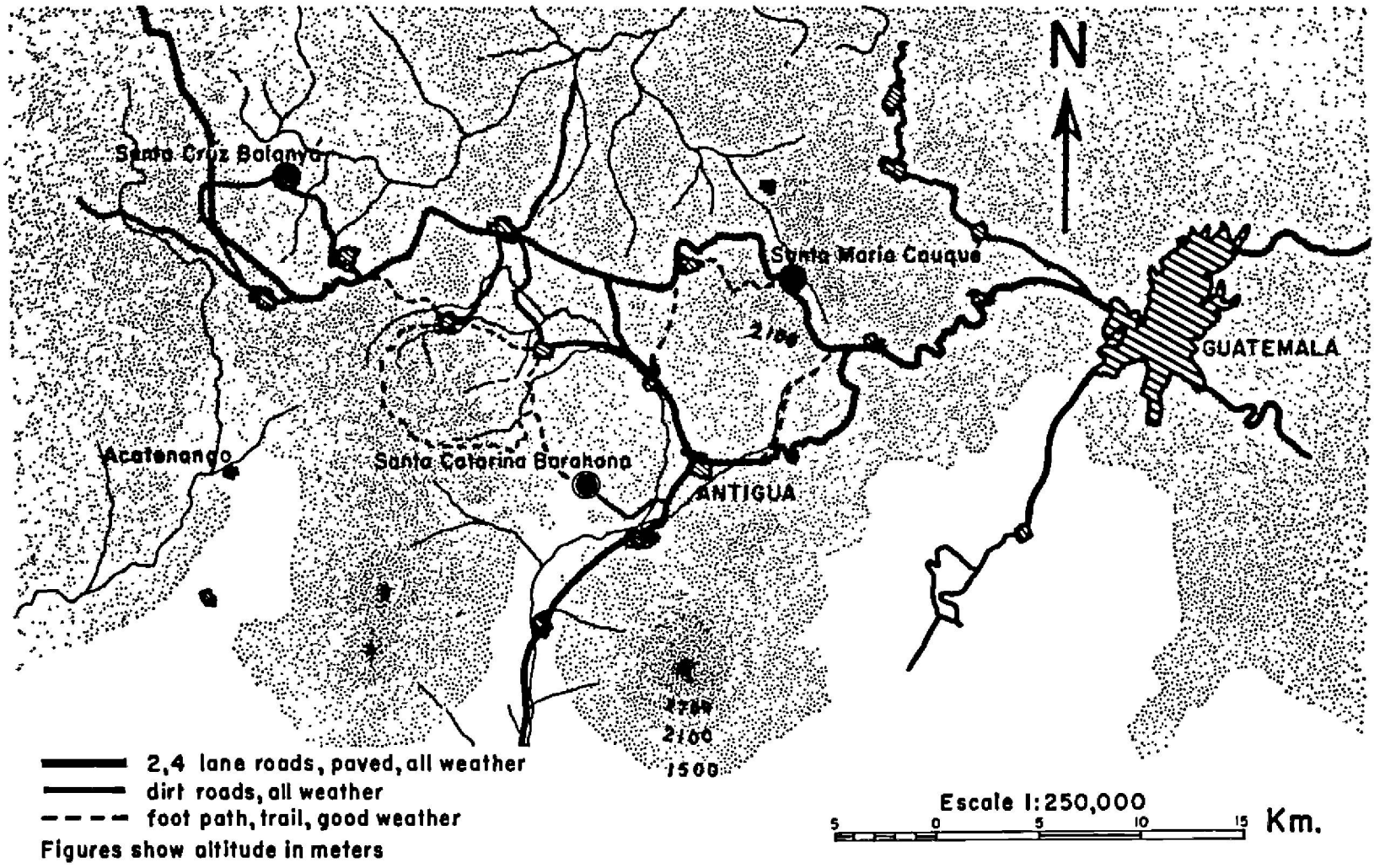


Fig 1.—Map of study area, Guatemalan highlands, showing the three study villages (Santa María Cauqué, Santa Catarina Barahona and Santa Cruz Balanyá), principal towns and cities, and elevations (in meters).

able results on incidence of infections and nutritional disease was met by three general population units of about 1,000 people each, providing observations were continued during five years.

The highlands of Guatemala are predominantly agricultural, with the people aggregated in villages. All are farmers except those providing the usual community services, such as shopkeepers and artisans. Weaving was a common home industry of the women. This mode of life greatly facilitated field study. The use of a single entire village for each of the specified purposes simplified operational procedures in respect to facilities, staff, and costs. It was also practical because communities in the neighborhood of 1,000 persons were common in the area.

The racial stock of populations of the study area is of two general classes, indigenous Mayan Indians, retaining a general mode of life and a cultural pattern centuries old; and Ladinos, who have mixed Spanish and Indian blood, but also Indians who have adopted Western culture in habits and dress. Villages tend to be mainly Indian or mainly Ladino, with Indian communities predominating in the highlands.

The qualities sought in the present study were villages of about 1,000, a predominant Indian population, located within a few minutes of a paved highway but with no through traffic in the village itself. The three villages were to be so spaced that intercommunication was minimal.

More than 20 villages approximating these requirements were investigated by field visit. The mayor of the village was interviewed as to number of residents, racial distributions, village activities, and economic conditions. The civil register was examined for causes of death in order to determine the kinds of prevailing illnesses and their relative frequency. Direct inspection of houses of poor, average, and better construction permitted cursory evaluation of living conditions and the quality of environmental sanitation. Talks with housewives were about diets and the feeding of young children.

Some visits were no longer than two hours; the area was palpably unsuited for one or another reason. Other villages rated repeated visits of two and three days. The eventual choice settled on Santa María Cauqué as the tentative site for the program of preventive medicine and medical care

Fig 2.—Class B housing, usual (tile roof, adobe walls, and adobe-brick or dirt floor).

(hereafter referred to as the treatment village); on Santa Catarina Barahona for the program of supplementary feeding (feeding village); and on Santa Cruz Balanyá to act as the control for these two activities (control village).

*Treatment Village.*—A number of field surveys by INCAP in Santa María Cauqué during the preceding several years had involved school children, nutritional problems and causes of deaths. In aid of this work, the ministry of health had constructed a simple clinic building which by agreement would be turned over entirely to purposes of the present study and managed by its staff. An appreciable amount of background information was available on current health conditions and on dietary practices. The village was mainly Mayan, the population was 923, and it was near a good highway. The existing facilities were attractive as a site for provision of medical and health services. Preceding dietary surveys of school children assured that nutritional conditions were those of the general area and that they had not changed in 10 years.

*Feeding Village.*—Santa Catarina Barahona also had been the scene of community nutritional surveys among school children, but the program did not include home visits. The results demonstrated its general comparability with Santa María Cauqué in respect to nutritional state of children. The information on causes of morbidity and mortality was less nearly complete although informative and useful. The population, 753, was somewhat smaller, but a lesser number of children was desirable because of the

**Table 5.—*Domestic Animals in the Study Villages, by Percentage of Families Owning Them, 1959***

| | Santa María Cauqué | | Santa Catarina Barahona | | Santa Cruz Balanyá | |
|---|---|---|---|---|---|---|
| | Animals | % Families With Animals | Animals | % Families With Animals | Animals | % Families With Animals |
| Cows | 13 | 0.6 | 0 | ... | 60 | 1.4 |
| Chickens | 1,786 | 78.6 | 1,358 | 90.8 | 2,591 | 60.8 |
| Pigs | 46 | 2 | 1 | 0.1 | 60 | 1.4 |
| Dogs | 115 | 5.1 | 62 | 4.1 | 270 | 6.3 |
| Others | 311 | 13.7 | 75 | 5 | 1,279 | 30 |

Fig 3.—Class C housing, poor (thatched roof of straw or palm, walls of cornstalks or sugar cane, and dirt floor).

greater complexity of the program of supplementary feeding. The population was Mayan and the communications good. The village adjoined a larger community, San Antonio Aguas Calientes, which was as well known as Santa María Cauqué from the standpoint of nutritional and infectious diseases. Two adobe houses of one room each were available from the village government to serve as study headquarters. It appeared a suitable site as the feeding village.

*Control Village.*—Santa Cruz Balanyá had all three of the specified characteristics. Its population of 1,363 was greater than either of the other villages and approached the sum of the two, which had been set as desirable. No surveys had ever been made, nor were there organized health facilities in the village. The local authorities would provide housing for study activities similar to those of Santa Catarina Barahoná. A reconnaissance more prolonged than usual, because of lack of baseline information, indicated conditions broadly comparable to the other two villages.

The geographical location of the three sites is shown in Fig 1, which also locates the nearest larger towns and cities but not the numerous intervening villages. The three study villages were separated from each other by natural barriers; mountains and valleys. The feeding village was nearer a city, Antigua, than the other two, but proximity to market centers was otherwise much the same.

*Criteria for Selection.*—A variety of problems had intruded into choice of study populations. To practice random selection of villages within a radius of 50 kilometers of Guatemala City, the base of operations, would bring difficulty in obtaining the desired size of population within a single village. Combinations of villages would be necessary in some instances and not in others. The kind of population would differ, for some villages were predominantly Mayan, others Ladino. Such a choice almost surely would have introduced unnecessary hardship in transport and time lost in travel by staff not resident in the field. One village might be to the east, another in the opposite direction with 100 kilometers separating them. The present choice grouped the three study sites in one general area with roads such that all could be visited within a single day. It also assured a homogeneity of the test population; all three villages were predominantly Mayan.

Fig 4.—Cooking is almost wholly on the floor of the one-room family living quarters.

Fig 5.—Village water point: water is piped from community reservoir or stream; laundering facilities; water carried to the household.

The health problems of preschool children, the primary unit of observation, relate strongly to the other persons living with and around them; school children and adults. Knowledge of the broad community and its characteristics is essential to interpretation of disease transmission, of the influence of environmental sanitation and dietary habits on nutrition, and of social customs and organization on death rates. Without this the study of nutrition and infection among young children becomes clinical rather than epidemiological and better done with facilities more comfortably located than in a Guatemalan village.

To split each of the three population fractions called for by the experimental design among several villages would cut the risk of chance occurrences affecting the results, events such as epidemics, natural disasters, or crop failures. It would give a more diversified study group. It also would have multiplied effort greatly because community characteristics would have to be determined and followed for multiple villages instead of one. For entire villages to serve a specified purpose was in some respects less desirable but it was more workable.

The next requirement was to determine whether the three villages were indeed comparable in the attributes of major consequence to the proposed investigation.

**Comparability of the Three Villages.**—The original choice of the three popu-

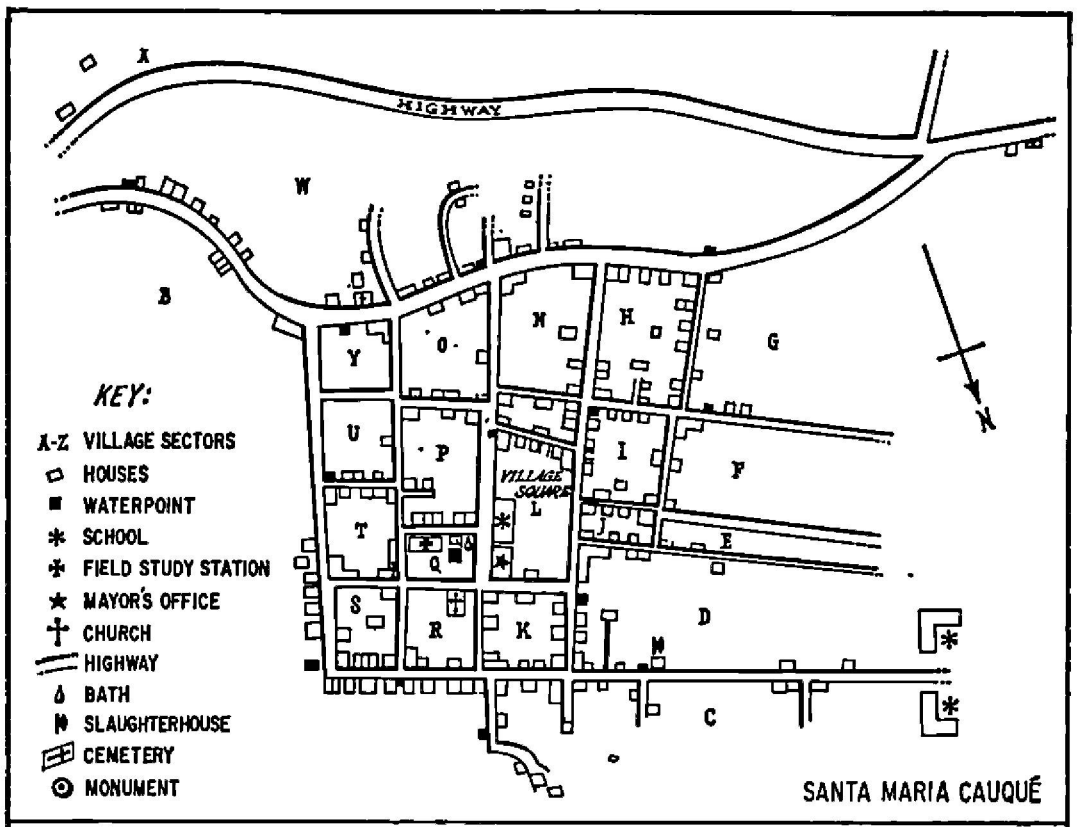


Fig 6.—Maps of Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village) showing divisions by lettered sectors and numbered houses.

**Table 6.—*Intestinal Parasites, Children Aged 0-4 Years, Study Villages, May 1959***

| | Santa María Cauqué (N=113) | | Santa Catarina Barahona (N=68) | | Santa Cruz Balanyá (N=118) | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Parasite | | | | | | |
| *Entamoeba histolytica* | 5 | 4 | 5 | 7 | 6 | 5 |
| *Entamoeba coli* | 20 | 18 | 7 | 10 | 17 | 14 |
| *Endolimax nana* | 4 | 4 | 4 | 6 | 4 | 3 |
| *Iodamoeba butschlii* | 7 | 6 | 3 | 4 | 3 | 3 |
| *Giardia lamblia* | 16 | 14 | 5 | 7 | 13 | 11 |
| *Chilomastix mesnili* | 9 | 8 | 9 | 13 | 8 | 7 |
| Trichomonas | 7 | 6 | 0 | 0 | 1 | 1 |
| *Ascaris lumbricoides* | 49 | 43 | 33 | 49 | 54 | 46 |
| *Trichuris trichiura* | 13 | 12 | 7 | 10 | 3 | 3 |
| Hookworm | 0 | ... | 0 | ... | 0 | ... |
| Others | 2 | 2 | 1 | 1 | 1 | 1 |
| Children | | | | | | |
| With parasites, all forms | 74 | 65 | 40 | 59 | 71 | 60 |
| With one parasite | 40 | 35 | 20 | 29 | 40 | 34 |
| With 2 to 4 parasites | 31 | 27 | 18 | 26 | 31 | 26 |
| With 5 or more parasites | 3 | 3 | 2 | 3 | 0 | ... |

lations was provisional, based on existing information and brief observation of people and environment. The final decision came after direct field measurement of population composition, of the prevailing death rates among children from birth until 5 years old, and of the existing nutritional state of that age group. This and other collected information was used to determine comparability of the three villages, one to another as well as the extent to which they were representative of the general area.

*Census.*—The approximate numbers of people in each village were available from the national census of 1950. The data were brought up to date by visiting all households within the village limits, noting all persons living there and their relationships to each other. Standard family folders were prepared as the basis for a census. Additional information was gathered on types of housing, sanitary facilities, water supply, domestic animals, and sources of income.

Table 2 shows the populations of the three villages in 1959 at the beginning of the study. The proportion of preschool children in relation to total population in Santa María Cauqué, the treatment village, was 21%, which was greater than the 14% in the feeding village and 16% in the control population. This information was in accord with average rates for live births during the preceding 10 years, which for the three villages were respectively 62.5, 42.9, and 55.9 per 1,000 population. The sexes within the age group 0 to 4 years were almost equally represented.

The birth rates are exceptionally high. With allowance for inadequacies in population count or allocation of population to a particular birth registration area which occurs in these irregularly populated mountain areas, the rates are still within the range for the country as a whole. In 1950 the general birth rate for Guatemala was 51 per 1,000 population per year. Rates are regularly greater in rural than urban areas, and Central America for years has had the highest birth rates in the Americas. The most recent report, that of 1965, shows a net natural increase of 3.4%/yr. These Guatemalan villages have a young population.

*Population Characteristics.*—The population of all three villages were predominantly Indian (Table 3). The divisions by economic status were made subjectively, according to Guatemalan village standards but guided by the qualities listed in Table 4. The feeding village would be considered about average for the general region, the treatment village somewhat better than average, and the control perhaps below the usual level.

*Housing and Environment.*—Living accommodations were better in the two test villages than in the control, but between those two the differences were not great (Table 4). Houses were classed as of better than usual quality (class A) if they had a metal roof, adobe or cement walls, and a cement floor; there were few of this description. A tile roof, adobe walls, and an adobe brick floor—the usual type—was recognized as

class B (Fig 2). Class-C, or poorer class, housing had thatched roofing of palm or straw, walls of cornstalk or sugar cane, and a dirt floor (Fig 3). Few houses had a kitchen, and still fewer had a stove (Fig 4), but more in Santa Cruz than in the other two villages. An open fire on the floor served for cooking.

Water is a precious commodity in the highlands. Almost all households draw their supply from water points located variously throughout the village (Fig 5). Water originates in a central supply and is piped into the village. The control village had more private sources within the household compound, either wells or taps, but public sources were measurably more remote and less easily accessible than in the other two villages.

A common arrangement was for the drinking water source to function also as the center for community laundering. Opportunity for contamination was relatively great. A small open collecting reservoir was often a part of the installation, and young children with little sense of responsibility were commonly the bearers of water from source to home.

Deficiencies in environmental sanitation were strongly evident in all three villages. Human wastes were seen in the surroundings of houses and along the walls bordering side streets. Three homes in Santa María Cauqué, and the study headquarters, had flush toilets. There were three in the feeding village, although constructed so that a running stream served in disposal. It also contributed to the water supply. The control village had no flush toilets.

Santa María Cauqué also was far better supplied with bored hole latrines than the other two villages, as the result of national health department activities in recent years. This was one reason for selecting the village as the site of preventive services; a start had been made and less remained to be done than in most villages. About one sixth of families in the other two villages had such facilities which is usual for the region. Their lack of repair and scant use were evident; children may have learned that the latrine was the place to put feces, but about as much was deposited around the facility as in it.

Disposal of other wastes was mainly a problem of animal feces and trash, for food was too scarce to waste. Burning accounted for part of the trash and burying the rest. Animal feces were ignored or used as fertilizer.

*Domestic Animals.*—The number of domestic animals and the proportion of families possessing them provide a practical measurement of economic state; they are indicative of potential supplies of animal protein; and they reflect additionally some of the problems of environmental sanitation. In all of the villages, cows were few, with somewhat more in the control than in the other

**Table 7.—*Nutritional State of Children Aged 0-4 Years, by Degree of Deficiency, Weight for Age, Guatemalan Study Villages, May 1959***

| Nutritional State | Santa María Cauqué (N=148) | | Santa Catarina Barahona (N=87) | | Santa Cruz Balanyá (N=165) | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Normal mean ±9% | | | | | | |
| Under 1 year | 21 | 61.8 | 8 | 30.8 | 25 | 56.8 |
| 1 year | 3 | 6.5 | 0 | ... | 2 | 3.8 |
| 2 | 0 | ... | 1 | 6.2 | 2 | 4.2 |
| 3 | 0 | ... | 0 | ... | 0 | ... |
| 4 | 0 | ... | 0 | ... | 0 | ... |
| Total | 24 | 16.2 | 9 | 10.5 | 29 | 17.6 |
| Malnutrition | | | | | | |
| 1st degree (−10% to −24%) | | | | | | |
| Under 1 year | 8 | 23.5 | 17 | 65.4 | 13 | 29.5 |
| 1 year | 18 | 39.1 | 13 | 50 | 22 | 42.3 |
| 2 | 8 | 30.8 | 12 | 75 | 21 | 44.7 |
| 3 | 16 | 38.1 | 11 | 61.1 | 12 | 54.5 |
| 4 | 0 | ... | 0 | ... | 0 | ... |
| Total | 50 | 33.8 | 53 | 61.6 | 68 | 41.2 |
| 2nd degree (−25% to −39%) | | | | | | |
| Under 1 year | 3 | 8.8 | 1 | 3.8 | 5 | 11.4 |
| 1 year | 21 | 45.6 | 11 | 42.3 | 27 | 51.9 |
| 2 | 17 | 65.4 | 3 | 18.3 | 20 | 42.6 |
| 3 | 23 | 54.8 | 7 | 38.9 | 8 | 36.4 |
| 4 | 0 | ... | 0 | ... | 0 | ... |
| Total | 64 | 43.2 | 22 | 25.6 | 60 | 36.4 |
| 3rd degree (−40 or more) | | | | | | |
| Under 1 year | 2 | 5.9 | 0 | 0 | 1 | 2.3 |
| 1 year | 4 | 8.7 | 2 | 7.7 | 1 | 1.9 |
| 2 | 1 | 3.8 | 0 | 0 | 4 | 8.5 |
| 3 | 3 | 7.1 | 0 | 0 | 2 | 9.1 |
| 4 | 0 | ... | 0 | ... | 0 | ... |
| Total | 10 | 6.8 | 2 | 2.3 | 8 | 4.8 |

**Table 8.—*Diets of Preschool Children, Average of 3-Day Periods, May 1959***

| | Santa Catarina Barahona (N=30) | Santa María Cauqué (N=30) | Santa Cruz Balanyá (N=30) |
|---|---|---|---|
| Calories | 687 | 907 | 836 |
| Total protein (gm) | 19.2 | 25.1 | 21.8 |
| Animal protein (gm) | 3.8 | 3.3 | 1.8 |
| Fat (gm) | 10 | 9 | 8 |

two (Table 5). Most families kept chickens but pigs were few. Dogs were fairly numerous, their main function being that of scavengers, although their usual high-grade malnutrition indicated the low efficiency of their efforts. Cats were relatively few, but still the most numerous in the category of "others," which included horses, goats, turkeys, an occasional goose, and rabbits.

*Intestinal Parasitism.*—The frequency of intestinal parasites provides an indirect measure of both sanitary conditions and prevalence of infection. Children under 5 years of age were examined at the beginning of the study, and the results are presented in Table 6. The differences between villages were inconsequential. Infection rates were high. In all, 62% of children under 5 years had a demonstrable intestinal parasite, a frequency which gains consequence in that colonization is less in the first year of life. Almost half of the children with parasites had more than one and a few had five or more.

*Death Rates.*—Both births and deaths were recorded in all three villages by a lay registrar, with much accuracy as to numbers and a reasonable reliability for age at the time of death. From early colonial days all persons have been required to carry an official identification card, and burials are not permitted without a death certificate signed by the authority responsible for the civil register. Ascribed causes of death, however, were both misleading and indefinite, for medical certification was virtually unknown.

A survey of the village registers for deaths in the villages during the preceding 10 years, the years ending April 1950 through April 1959, gave crude death rates of 24 per 1,000 population per year in Santa María Cauqué, 25 in Santa Catarina Barahona and 31 in Santa Cruz Balanyá. Infant mortality was high in all three villages, 136, 182, and 186, respectively. Death rates for children 1 to 4 years old were essentially equal in the treatment and feeding villages, at 50 and 56 per 1,000 per year at those ages, and appreciably greater in the control village, 81 per 1,000.

As in developing countries generally, all of these rates were high and substantially greater than now. They were in general agreement with reported death rates for the country as a whole during that period. In 1950, the crude death rate for Guatemala was 22, infant mortality 107, and for ages 1 to 4 years the death rate was 41. While annual crude death rates in urban communities of the country are greater than in rural areas, infant mortality in rural areas has averaged about 22% more than in cities and also is in excess in the second year of life. In later years of the preschool period, rural rates are slightly less than in cities. The higher rates for infants and toddlers in the villages before the study were thus in conformity with usual experience.

The greater proportion of preschool children in the general population of Santa María Cauqué than in the other two villages, as noted earlier, is presumably due in part to a higher birth rate but also to a lower infant mortality. While the observed death rates in the treatment village introduced a bias against the village, they favored a proportionately good result because a start in use and understanding of medical services seemingly had been made.

No information on past general morbidity among preschool children was available for these specific villages. Reporting of cases was nonexistent and the nature of prevailing illnesses could not be determined reliably from stated causes of death. A reliable index was, however, at hand from experience gained in other studies, with no reason to suppose that these villages departed from usual observed incidence, or differed among themselves.

*Nutritional State.*—Judgment on the nutritional state of preschool children in the study villages was based on three kinds of evidence. The first was through comparison of observed weight for age compared to INCAP standards for well-nourished children.[7] The second was through studies of dietary intake for randomly selected children

of the three villages. The third source was from results of physical examination of preschool village children, with main emphasis on symptoms and signs commonly associated with specific nutritional disorders.

WEIGHT FOR AGE.—An outstanding feature of the anthropometric data in Table 7 was the small proportion of preschool children with weight for age within 10% of standard mean values. While this was true of all villages, it was most marked in the feeding village. With few exceptions the only well nourished children were early in the first year of life while still adequately breast fed.

When numbers of children with a normal nutritional state were combined with first degree malnutrition, the children of the feeding village were easily the better nourished at the beginning of observations, with the control village second, and the treatment village third. These differences are of course reflected in frequencies of combined second and third degree malnutrition, where 50% of treatment village preschool children were in this more severely malnourished class, 41% of the control and only 28% of the feeding village.

DIETARY INTAKE OF PRESCHOOL CHILDREN.—A group of 30 children in each village, representing all ages from 0 to 4 years, were surveyed by the Dietary Survey Division of INCAP to determine relative food intake by young children of the three villages.[10] The findings as of May 1959, at the beginning of the study, and presented in Table 8, show that children of the treatment village were receiving the better diet in terms of both calories and grams of protein and yet were of a poorer nutritional state than those of the feeding village. This paradox suggests a possible sampling variation or an influence of factors other than food intake in determining nutritional state, perhaps frequency of infection.

**Table 9.—*Clinical Signs of Nutritional Disease, Children 0 to 4 Years of Age, Three Study Villages, Guatemala, May 1959***

| Clinical Sign or Symptom | Santa María Cauqué (N=150) | | Santa Catarina Barahona (N=87) | | Santa Cruz Balanyá (N=166) | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Hair | | | | | | |
| Pre-flag and flag sign | 25 | 17 | 11 | 13 | 26 | 16 |
| Conjunctiva | | | | | | |
| Inflammation | 5 | 3 | 7 | 8 | 7 | 4 |
| Dryness | 33 | 22 | 9 | 10 | 15 | 9 |
| Thickening | 52 | 35 | 10 | 12 | 20 | 12 |
| Generalized vascularization | 21 | 14 | 21 | 24 | 10 | 6 |
| Blue-Black pigmented spots | 69 | 46 | 47 | 54 | 64 | 39 |
| Vascularization of exposed conjunctiva | 77 | 51 | 34 | 39 | 74 | 45 |
| Cornea | | | | | | |
| Limbal vascularization | 1 | <1 | 3 | 3 | 2 | 1 |
| Naso-labial seborrhea | 0 | 0 | 0 | 0 | 0 | 0 |
| Bilateral erythema | 12 | 8 | 5 | 6 | 14 | 8 |
| Depigmented spots, all forms | 27 | 18 | 6 | 7 | 28 | 19 |
| Lips | | | | | | |
| Acute cheilitis | 3 | 2 | 0 | ... | 0 | ... |
| Stomatitis | 2 | 1 | 0 | ... | 1 | <1 |
| Gums | | | | | | |
| Gingivitis | 1 | <1 | 2 | 2 | 0 | ... |
| Hypertrophy | 3 | 2 | 5 | 6 | 2 | 1 |
| Tongue | | | | | | |
| Red | 3 | 2 | 1 | 1 | 1 | ... |
| Edematous | 4 | 3 | 0 | ... | 0 | <1 |
| Fungiform papillary hypertrophy | 14 | 9 | 8 | 9 | 3 | 2 |
| Filiform papillary hypertrophy | 14 | 9 | 7 | 8 | 17 | 10 |
| Atrophy | 2 | 1 | 0 | ... | 0 | ... |
| Geographic tongue | 1 | <1 | 1 | 1 | 1 | <1 |
| Teeth | | | | | | |
| Caries | 15 | 10 | 12 | 14 | 15 | 9 |
| Serrated borders | 3 | 2 | 1 | 1 | 2 | 1 |
| Atresia | 12 | 8 | 0 | 0 | 19 | 11 |
| Malposition | 4 | 3 | 1 | 1 | 11 | 7 |
| Spotted enamel | 20 | 13 | 14 | 16 | 14 | 8 |
| Mucous membranes | | | | | | |
| Paleness | 7 | 5 | 9 | 10 | 0 | ... |
| Neck | | | | | | |
| Parotid hypertrophy | 0 | ... | 0 | ... | 0 | ... |
| Goiter | 0 | ... | 0 | ... | 1 | <1 |
| Skin | | | | | | |
| Xerosis | 7 | 5 | 1 | 1 | 19 | 11 |
| Follicular hyperkeratosis | 7 | 5 | 3 | 3 | 4 | 2 |
| Nails | | | | | | |
| Transverse striations | 8 | 5 | 2 | 2 | 2 | 1 |
| Subcutaneous tissues | | | | | | |
| Edema | 1 | <1 | 1 | 1 | 1 | <1 |

CLINICAL NUTRITIONAL DISEASE.—Pre-

school children of the three villages were examined for clinical evidence of specific nutritional disease with the results presented in Table 9. Signs suggestive of nutritional deficiency were relatively few. The eye changes were probably due to dust, smoke in the houses, and previous conjunctivitis. Significant differences between villages were not established.

**Mapping.**—Coincident with the census and environmental survey, maps of the three villages were prepared, showing the location of each household, water source, and prominent landmark. Streets had no names. Villages were divided arbitrarily into lettered sectors and each household given a number. The maps served in planning routine field visits and as a check on the census. Population is most concentrated around the village square. Streets, or rather the dirt lanes which separate houses, are of irregular pattern (Fig 6). The maps served a later purpose of spotting cases of malnutrition and infectious disease, and tracing lines of spread of infection in the communities. By inserting pins of different color for each month and a separate map for each disease, spread of infection could be visualized. Permanent records were made by overlays.

## Transition to Data Collection

The information gathered in the three villages on living conditions, on numbers and characteristics of the people, on illnesses and deaths and the nutritional state of young children was critically reviewed, relating each element to the others, in the endeavor to determine comparability.

Each of the seven characteristics just listed was assigned an arbitrary value, weighted according to significance to the stated objectives of the study. A particular characteristic as observed in each of the three villages was then graded on a scale of 10. Discrepancies between villages existed in respect to some items, and there was conflicting evidence regarding others; but in a natural population of humans, such divergences are inevitable. One criterion sometimes favored a particular village; the result in another neutralized the difference. For example, Santa Cruz families more often had an individual water supply, but the Santa Catarina households were closer to a public source. Housing was poorer in Santa Cruz, but that village had more animals per family. Decision rested on a summation of evidence, with the result that the three populations were considered to be as nearly equivalent and justifiably comparable as could be achieved for the purposes for which each was intended.

That these three communities were representative of the area in social and economic status and in general mode of life is supported by data on environmental conditions, death rates, and nutritional states from more than 20 other villages, and a general field experience in the region during a decade. Ladino villages ordinarily were in advance of Mayan Indian communities, especially the larger towns and small cities, in sufficient degree to support the decision for a predominantly Mayan population, which was also the largest population element in the central highlands.

With study area and population decided, the next demand in transition to active collection of data was a careful prescription of methods to be followed and techniques to be employed—in administrative parlance, the preparation of a standard operating procedure. This is the subject of the paper to follow. The study itself was conceived as having two stages, the first a pilot investigation to test methods, train staff, and obtain a preliminary opinion of the validity of the concept under trial, a synergistic interaction between nutrition and infection. With favorable answers to these questions, the study proceded to a second and operational stage, a prospective and definitive investigation to last 5 years.

## Summary

A Guatemalan rural highland area was selected for field study of nutrition and infection in early childhood. A preliminary survey to determine the particular site of operations had administrative and technical aspects.

Working arrangements were established with governmental authorities, national and local. The likely cooperation by people, the extent of population migration, and readiness of access to the study area were evaluated. The presence of other field studies was

investigated for possible conflict or aid to the present investigation.

Technical features of the reconnaissance included existing disease prevalence, death rates of immediately preceding years, and the existing provision of public health and medical services. The physical geography of the area was considered in possible relation to disease prevalence and severity. The decision was taken to limit observations to Mayan Indian communities because they were most numerous.

A survey of some 20 villages of the desired size, approximately 1,000 people, led to selection of three as study populations, the first to have a program of integrated medical service, the second a feeding program, with the third serving as a control.

The selected villages were examined for comparability. A de jure census was taken and the predominant racial stock determined. Economic status, housing and environment, population of domestic animals, and extent of intestinal parasitism among village residents were evaluated. Death rates were determined from local records. Nutritional state in early childhood was measured by three criteria, weight for age, dietary intake by survey, and physical examination for specific nutritional disease. By these characteristics the populations were judged comparable and suited each to its particular purpose.

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### CHRONIC RESPIRATORY DISEASES

The chronic respiratory diseases are a public health problem of very considerable magnitude. In 1963, they accounted for more than 32,000 deaths in the general population of the United States and, as our study shows, this figure greatly understates the extent to which these diseases contribute to the death toll. If recent trends continue, the number of deaths for the chronic respiratory diseases will reach much higher levels in the near future.—Reported Frequency of Chronic Respiratory Diseases as Causes of Death: Age Variations, *Statistical Bulletin* 46:6-9 (Aug) 1965.