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Kottar: Malnutrition, Intervention and Development in a South Indian District

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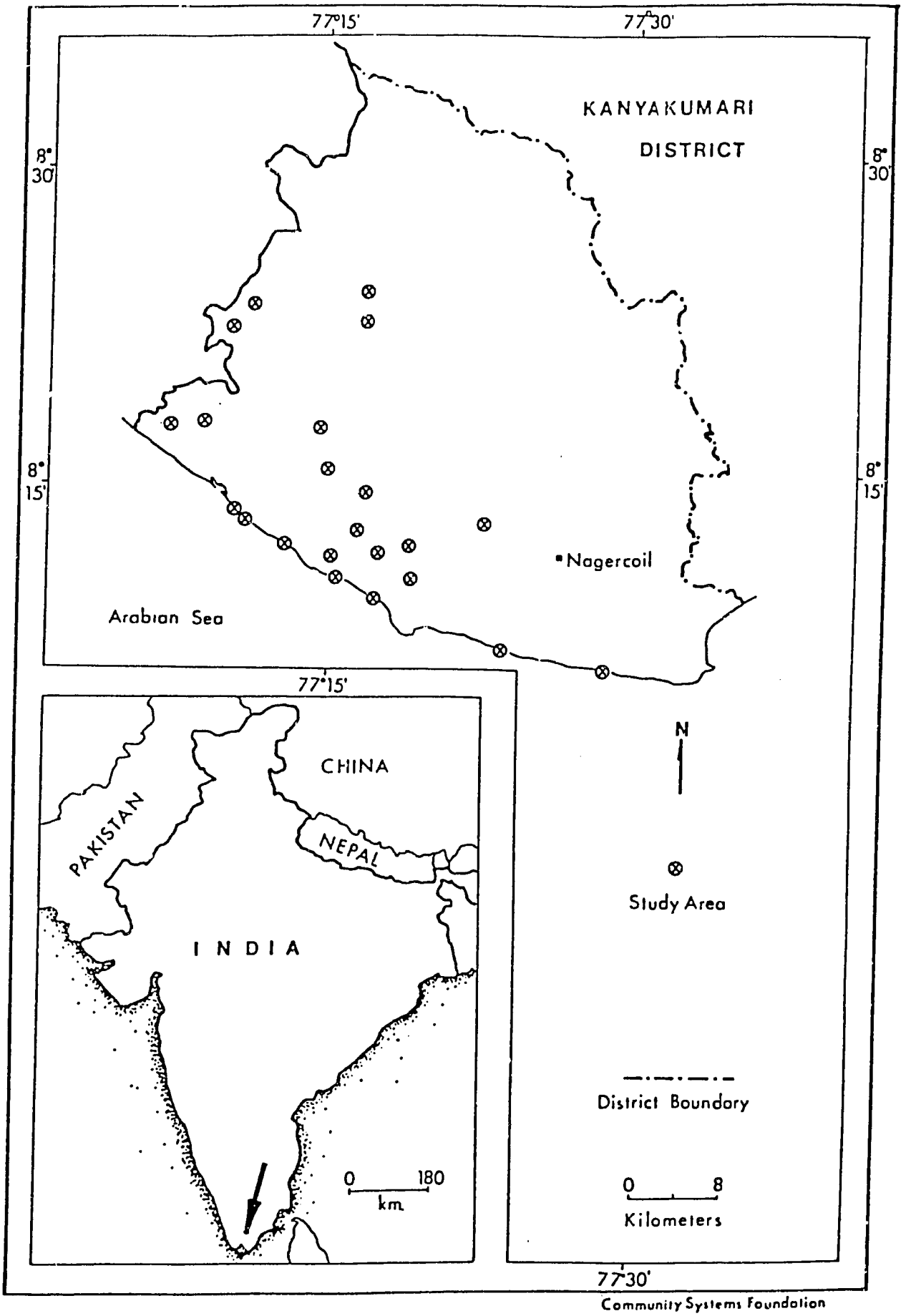
KOTTAR SOCIAL SERVICE SOCIETY--

STUDY AREAS



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SUMMARY

Kanyakumari District

Kanyakumari, in the state of Tamil Nadu, is the southern-most district in India. It is small (645 square miles) and densely population (726 persons per kilometer, or 1.3 million people in all). Literacy rates are unusually high for India (62 percent); and 39 percent of the population is Christian, of whom half are Catholic. Poverty, however is extensive: 55 percent of those who own land own less than an acre, and 30 percent of the families earn less than Rs. 100 ($13) per month. Infant mortality is low by Indian standards, but malnutrition is widespread among small children.

The Kottar Social Service Society (KSSS)

KSSS is an indigenous voluntary agency in Kanyakumari District affiliated with the Catholic Church. Founded in 1962, it sponsors a wide range of community development projects, including a Community Health Development Project (CHDP) established in 1972. The CHDP features take-home supplementary feeding (made possible by American food aid), nutrition and health education, simple health care, and the monthly monitoring of child growth performance. It covers more than 40,000 children in 124 villages.

The Kottar Data Set

Collected in September 1977 from a random sample of children registered in the CHDP at the time, the data pertain to 4,142 children (3,356 after cleaning) living in 21 villages. Included in the data set are longitudinal weight entries and health diagnoses as well as cross-sectional information on family composition, socioeconomic characteristics, and immunizations.

Principal Findings

- Findings vary significantly depending on the standards of normal growth and indicators of nutritional status employed. The mode of analysis is especially influential in determining outcome.
- Kottar children appear to exhibit a pattern of steady growth failure during the first year following birth when the Harvard standard is used. Subsequent growth is normal but well below the Harvard standard. (Figure 1)
- In July 1977, only 4 percent of the sample were within the range of normal growth according to the Gomez classification (NCHS/CDC reference medians), while 56 percent were experiencing first degree malnutrition, 36 percent second degree, and 4 percent third degree. The average child weighed 76 percent of standard.
- Neither age of entry into the Community Health Development Project nor length of time in it is related to nutritional status. Similarly, multiple-input villages reveal no nutritional improvement relative to CDHP-only villages.
- Both the incidence and severity of malnutrition differ markedly across the villages, even when region is held constant. (Figure 3)
- When age cohorts are compared over time, there is clear evidence of an improvement in nutritional status in the sample population between January 1975 and July 1977. (Table 3)

- Improvement is even more pronounced for severely malnourished children. (Table 5) In addition, early childhood mortality appears to have dropped markedly.

- Both the incidence and severity of malnutrition are responsive to shifts in the price of rice, suggesting that exogenous forces beyond the capacity of an intervention to control exert a potent influence. (Figure 6)

- While there are "soft" indicators which would lead us to attribute the positive changes to the KSSS program, we are unable to resolve completely the ambiguity of attribution between the effects of the price of grain and those of the program.

- Substantial differences in economic well-being are associated with marginal differences in nutritional status. There would appear to be a "nutrition barrier" at work in much social and economic improvement. Education and nutrition are closely linked, but even high educational attainments by mothers and fathers coexist with widespread malnutrition among their children.

- Malnutrition is clearly tied to health status, suggesting that much socioeconomic change fails to alter the broader health dynamic of which malnutrition is a part.

- Malnutrition varies with family size. The more children, the greater and more severe the malnutrition. Other family characteristics tend not to discriminate well.

- Religion, caste, and occupation are of little consequence to nutritional status.

- The sex of a child is nutritionally neutral when the NCHS/COC standards are employed. Sex is very much a factor when the standards of the Voluntary Health Association of India are employed, females having substantially more malnutrition than males.

- Utilization of multivariate analysis techniques confirms most of our findings regarding the determinants of nutritional status using bivariate analysis. Nutritional status of children are found to be related with statistical significance to child age and sex, number of children in the family, sickness, family income, available land and village type.

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INTRODUCTION

This monograph reports on data defining the socioeconomic and programmatic parameters of malnutrition in Kanyakumari District at the southern tip of India. The data were generated by the Kottar Social Service Society (KSSS), an indigenous voluntary agency affiliated with the Catholic Church in the diocese of Kottar. Since 1972, the Society has managed a Community Health Development Project (CHDP) encompassing take-home supplementary feeding, nutrition and health education, simple health care, and the monthly monitoring of child growth performance. As of September 1977, when sample data were coded, the CHDP covered 42,498 children in 124 villages.[1] Our sample consists of 4,142 children from 21 of those villages.

The Kottar data invite analysis for several reasons. One is that Kanyakumari District features a relatively low incidence of infant mortality together with rather high levels of malnutrition, an unusual combination. The infant mortality rate in 1961 was estimated at 61.7 per 1,000 live births, or less than half of the Indian national average.[2] On the other hand, our own

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[1]For a detailed review of the Kottar program, including the Community Health Development Project, see John Osgood Field, "Development at the Grassroots: The Organizational Imperative," The Fletcher Forum, 4 (Summer 1980), 145-164.

[2]Census of India 1961, Volume IX: Madras, Part X-XII, District Census Handbook: Kanyakumari (1966), p. 45. The infant mortality rate for India was estimated at 139/1,000 in the late 1960's. Source: Population Reference Bureau, Inc., World Population Data Sheet, 1973.

data for 1977 reveal less than 5 percent of our sample under age five experiencing normal growth, with second degree malnutrition characterizing more than a third of the children and third degree malnutrition characterizing 3 percent or more. The average child in the Kottar sample was only 73-76 percent of standard weight-for-age between February 1974 and August 1977.[3]

Granted that the mortality estimates are deflated (by under-reporting) and that the malnutrition figures are probably inflated (by the nature of the sample and by the standards and cut-off points employed), the fact remains that Kanyakumari resembles the high malnutrition-low mortality anomaly of Sri Lanka[4] more than the usual pattern of high early childhood malnutrition and mortality found elsewhere. In Kanyakumari, as in Sri Lanka, malnutrition does not result in infant mortality even though both typically reflect the same underlying causes. If so, this suggests that many children live dangerously close to the margin where incremental shifts in well-being result either in death or more commonly in survival in a chronically malnourished state.[5]

Other explanations of the high malnutrition-low mortality anomaly are quite plausible. Perhaps the children appear more malnourished by Western standards than they really are. There may be some genetic cause for insufficient growth by Western standards or some other growth-limiting dietary

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[3]These figures are based on the Gomez classification using Harvard standards.

[4]According to the nutrition status survey of 1975-1976, 42 percent of the preschool-age children in Sri Lanka were at least moderately malnourished, with 3.9 percent being severely malnourished, in the face of an infant mortality rate of only 45/1,000. See Sri Lanka Nutrition Status Survey, 1976 (Office of Nutrition, Agency for International Development, Washington, D.C.).

[5]See the discussion of age and time flows below.

deficiency which does not equate to poor health. Still, using traditional methods of measuring nutritional status, the children do appear to be malnourished.

Given that malnutrition among rural children in Kanyakumari District is pervasive and often quite serious, what conditions it? What are the ecological and socioeconomic dynamics of malnutrition which exist there? How does malnutrition vary from one part of the district to another and also across different social groupings?

We are able to probe these parameters of the problem because Kanyakumari, while physically small, is remarkably heterogeneous.[6] It has fishing villages, agricultural villages, and villages featuring distinctive religious, caste, and occupational characteristics. By the same token, only one major road traverses the district, thereby giving rise to pronounced differences in proximity to the modern market system of goods, services, amenities, and credit. For their part, the Kottar data include--in addition to child weights over time--health diagnoses (also over time), immunization records, family histories, (size, birth spacing, mortality), socioeconomic attributes (religion, caste, education, occupation, income, savings and debt status), and objective living conditions (type of dwelling; ownership of land, animals, catamarans, and nets; sanitation, electricity, and water source; and related indices of modernization).

The richness of the longitudinal and cross-sectional data, reflecting the diversity of people and conditions in Kanyakumari, makes it possible for

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[6]Kanyakamari measures 645 square miles (1,572 kilometers), or approximately three-fifths the size of Rhode Island.

us to relate malnutrition to many of the circumstances with which it might be expected to vary and then to weigh alternative influences against one another so as to establish which factors are really important and which are not. These themes are addressed in Section IV.

Another major reason why the Kottar data merit analysis is that the Community Health Development Project (CDHP) features operational characteristics which are truly impressive while possibly being replicable on a larger scale.[7] These features and their potential significance invite assessment of the CHDP's impact on malnutrition, an opportunity which acquires added meaning by virtue of the fact that the Kottar program in its entirety is neither a research project orchestrated by professors nor a pilot or demonstration project possessed of all sorts of special and, hence, atypical qualities. If Kottar is, in fact, more "real" than the usual interventions from which a veritable harvest of data flow, the lessons to be learned from the Kottar attempt to alleviate malnutrition may also be more realistic in terms of the transferability of experience.[8]

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[7]When replication refers to more than an intervention type or input so as to include leadership and management skills along with operational sensitivity making for positive system-society interaction, it becomes--by definition--very much more problematic. As Field, op. cit., indicates, we doubt whether the Kottar approach is, in fact, replicable, both spatial expansion and a shift in sponsorship having disturbing implications. For a penetrating analysis of comparable experience in Maharashtra, see David F. Pyle, Project to Program: The Study of the Scaling-Up/Implementation Process of a Community-Level, Integrated Health, Nutrition, Population Intervention in Maharashtra (India), doctoral dissertation, Department of Political Science, Massachusetts Institute of Technology (October 1980), 313 pp.

[8]For a review of other nutrition-health interventions where impact has been assessed, see Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray, Can Health and Nutrition Interventions Make a Difference?, Overseas Development Council, monograph no. 13 (February 1980), and Arnfried A. Kielmann, Clayton

The CHDP is described in considerable detail elsewhere.[9] Suffice it here to summarize the more salient highlights. One highlight is the project's coverage, more than 42,000 children in 124 villages, or roughly three-quarters of the eligible low income families with preschool-age children in the district. Another is the fact that the services are provided in the villages themselves, this being possible because of the successful recruitment and training of village girls to implement the CHDP. More than 500 young women have worked in the project to date, and those still active are now organized into teams permanently located in the participating villages.

There are three additional features of note. The CHDP is not imposed; it is established in a village only upon request and only after the village has agreed to certain terms. Moreover, the CHDP is not free. Beneficiaries pay for what they receive, and the project is entirely self-supporting in its recurrent costs.[10] Finally, the intensity of participation by families registered in the CHDP is remarkably high: 96 percent when intensity of participation is measured as the percentage of monthly weight entries to total time in the program. When one notes than more than one-third of the sample children were weighed at age two months, with two-thirds being weighed in all

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A. Ajello, and Nandita S. Kielmann, "Evaluation of Nutrition Intervention Projects," final report to the Documentation Coordinator, TA/PPU/EUI, Technical Assistance, Agency for International Development, Washington, D.C. (1980).

[9]Field, op. cit.

[10]This is not to say that Kottar does not extract resources from the outside. It does so most effectively, particularly in terms of acquiring supplementary food (from Catholic Relief Services), vehicles, and some medicines. The extensive training given to young women in the CHDP is also made possible by external funding.

monthly cohorts between six and 13 months of age, and that the average duration of membership is 20 months, it becomes clear that the amount of interaction between the CHDP and its intended beneficiaries is both considerable and sustained.[11]

In short, the Community Health Development Project run by the Kottar Social Service Society functions quite impressively in its environment. The mechanism is in place; the things that are supposed to happen do happen; they happen with a continuity and regularity which may be unparalleled in grassroots ventures of this kind; and the target population is effectively engaged. These are the conditions which make it possible--and meaningful--to assess impact. Are the children served by the CHDP observedly better off as a result? Or is it perhaps wishful thinking to expect nutrition interventions based on the delivery of services, no matter how well implemented, by themselves to improve the nutritional status of children in poor families when the broader context in which the interventions are introduced is so unfavorable to their well-being? The question of impact is addressed in Section III; it is a question which raises a core practical as well as theoretical concern: whether nutrition interventions are, in fact, viable means of producing nutritional betterment.[12]

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[11]Twenty months is actually an underestimate, since both younger and newer children in the CHDP would bring the average down. See Appendix I for an elaboration of these patterns.

[12]As noted by Field, op. cit. (p. 147), "basic protein-calorie malnutrition has a complex etiology that makes it highly resistant to remedial attention under anything less than the most focused, intensive and sustained circumstances. While the international nutrition planning community is still attempting to learn what works, under what conditions, and why, the evidence to date is clear in one critical respect: single-shot inputs, such as

The Kottar data also permit a crude but useful assessment of the contributions to nutrition made by other KSSS activities on top of the CHDP. The Society sponsors a variety of food-for-work and self-help schemes, from soil erosion projects and the construction of tube wells and water tanks to the digging of irrigation channels, resettlement of villages, and promotion of environmental sanitation. Under Kottar auspices, fishermen, pottery makers, palmyra climbers, and other marginal producers have been organized into sangams (cooperatives) designed to circumvent marketing-and credit-providing middlemen, thereby undercutting the stranglehold of traditional moneylenders. KSSS has organized the weaving of nylon fishing nets along the coast and a variety of cottage industries inland. In its entirety, the Kottar presence in Kanyakumari District is an impressive manifestation of the equity-oriented "basic human needs" model of development; and the Kottar data offer the prospect of determining what manner and combination of inputs it really takes in order to achieve nutritional results in an environment where few have much and most have hardly anything at all.

Lastly, the Kottar data set represents a test of what broader value lies in nutrition, health, and socioeconomic data gathered not to stimulate scholars but to educate and assist practitioners. Studies of nutrition

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supplementary foods, are typically not sufficient. Indeed, it may be only a slight exaggeration to say that most nutrition interventions in fact have very little effect on nutritional well-being. The reason is that there is a mismatch between the problem and the response to it. The former is large, diverse, subject to multiple determinants, and embedded in a syndrome of deprivation. The latter, all too often, is small-scale, mono-emphatic, isolated and intermittent. Even at their best, most nutrition interventions are simply inadequate. This may be called the 'null hypothesis' of nutrition planning. It is derived from the apparent fact that protein-calorie malnutrition is less affected by nutrition interventions than by more broad-gauged strategies of development."

interventions have typically been conducted by professors monitoring the results of their own controlled experiments.[13] By contrast, the Kottar data reflect a real-world situation. That the data are less than perfect is an understatement. The question is, by virtue of being more real, are they also more revealing?

The Kottar sample contains 4,142 preschool-age children (3,556 after cleaning) enrolled in the Community Health Development Project in September 1977.[14] The sample children represent just under 10 percent of the total number of children (42,498) registered in the CHDP at the time.

The children were selected randomly but not from all 124 villages participating in the CHDP. Instead, the Kottar leadership had identified 21 villages on the basis of each possessing a distinctive characteristic in which the leadership was interested.[15] We then sampled 40 percent of the 10,442 registered families from these 21 villages, taking care to include only one

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[13]The three-village study in Guatemala and the Narangwal project in Ludhiana District of India's Punjab are notable examples.

[14]This is when Field and Pyle were in Kanyakumari District to organize the coding of data off the growth charts and family records maintained by the Kottar program. The data were transcribed onto a coding form (Appendix XIV) by 12 CDHP workers and then sent to the United States, where they were keypunched, cleaned, and prepared for analysis. Appendix XV describes the extensive cleaning procedures employed by the Community Systems Foundation data base management system on this data.

[15]Each of the 21 villages illustrates some aspect of the district's ecology or the nature of KSSS activities (see Table 1). In this respect, if not in others, none of the villages is typical, although each is representative of a tendency in the district and, taken together, they probably summarize the range of conditions quite well. This is certainly the belief of the Kottar leadership.

TABLE 1: THE KOTTAR SAMPLE

Region	Village	Distinctive Characteristic	Total Families in CHDP	Total Data Available	Sample: N and % of Total Families
Coast	Colachel	poor hygiene	430	121	121: 28%
	En. Puthenthurai	resettlement scheme, nylon center	341	222	132: 39%
	Enayam	low education	539	256	208: 39%
	Kadiapatanam	near KSSS coastal HQ	275	160	149: 55%
	Mel-Manakudy	close to town	331	156	130: 39%
	Midalam	isolated	336	146	134: 40%
	Pallam	average	341	209	136: 40%
Interior	Allanvillai	good cooperation	350	108	108: 31%
	Kalimar	average hygiene	541	277	216: 40%
	Kandanvilai	high education	649	465	260: 40%
	Konamkadu	CHDP relatively new	415	217	167: 40%
	Kulasekaram	no other KSSS activities	650	373	255: 39%
	Manguzhi	good cooperation	637	476	257: 40%
	Melpalai	good primary health centre	774	374	307: 40%
	Muragumudu	near main road	600	230	220: 37%
	Palliady	weavers	870	451	349: 40%
	Parakunnu	food-for-work	618	309	244: 39%
	Puthukadai	fish mongers	374	241	153: 40%
	Siluvaipuram	palmyra climbers	833	360	329: 39%
	Thirumalai	potters and landless laborers	90	90	90: 100%
	Vattam	early CHDP site	448	199	177: 40%
			10,442	5,440	4,142: 40%

child per family and only children for whom family histories and socioeconomic profiles had been obtained.[16]

Sample children, therefore, are not necessarily representative of all children enrolled in the CHDP, much less all children in the district.[17] To some unknown extent, they probably reflect the distinctive characteristics of the villages where they live, a possibility which receives partial confirmation from the fact that the nutritional profiles of the chosen villages differ markedly.[18]

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[16]In two villages, Colachel and Allanvilai, 40 percent produced a number greater than the cases available and we simply accepted those cases without attempting to make up the difference. In another village, Thirumalai, the number of participating families was so small that we again included all available cases. With these three exceptions, the sampling of children was random.

[17]The approach to sampling described above was dictated very largely by circumstance. It would have been logistically impossible to sample randomly among all children in the CHDP, the growth charts (with family and child identification numbers) being dispersed in the villages themselves. Various fallback positions, such as sampling randomly among the villages and then among the children in each village, were abandoned for similar reasons involving operational difficulties of identification and access.

[18]See the "time flow" discussion below. That sample children may reflect the distinctive characteristics of their villages, as against other characteristics that are less distinctive, follows from another feature of the selection process. For many families in the 21 villages, the Kottar leadership was obliged to add socioeconomic data to the growth-health data on a crash basis. Some bias is introduced here in that the socioeconomic data were gathered principally and sometimes exclusively for those families in a village who typify the distinctive characteristic which was the reason for the village's selection in the first place. Some types of people--those with especially low educational attainments in Enayam, for example--are likely to be over-represented as a result. The actual significance of this kind of bias in the sample is unclear, however. From the beginning, one objective of the study has been to learn which characteristics of the children, their families and villages are most relevant to differences in nutritional well-being. We address this question in Section IV below.

There are other reasons why the sample is not strictly representative. The CHDP is not targeted to the average child in Kanyakumari. Children residing in the district's several towns are bypassed in this village-oriented project. By the same token, there is an income qualifier; in order to be eligible for the CHDP, families are not supposed to earn more than Rs. 1,800 ($230) per year. The intended beneficiaries are children of relatively poor families.[19] Moreover, both by virtue of the mode of the CHDP's expansion, a process which relies heavily on local parish priests, and by virtue of the fact that Christians in the district (and Catholics especially) are among the lowest income groups, there is also a pronounced religious bias in the families recruited into the program notwithstanding Kottar's non-sectarian creed. Catholics comprise 20 percent of the population in Kanyakumari, but Catholic children make up 52 percent of our sample.

In sum, there are several biases in our data which make it impossible to refer, with precision, to the district as a whole or even to those villages served by the CHDP. On the other hand, if certain characteristics are not represented statistically in the sample as they appear in the district, it is still possible to assess the substantive significance of different characteristics with regard to growth performance, this being a major objective of the study.

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[19]KSSS accepts a poverty line of Rs. 150 per month for a family of five, or Rs. 37 ($4.75) per person per month. Our data indicates that the income qualification may be observed in the breach. Half of the families with sampled children reported incomes of Rs. 2,000 or greater, with a fifth of all families declaring a total annual income of Rs. 5,000 ($640) or more. Of course, income is very difficult to specify in settings such as this; and we are inclined to doubt the accuracy of such claims.

Three additional limitations of the data warrant brief mention. First is the problem of quality control. All the available data were gathered by village girls trained under Kottar's auspices to provide CHDP services, not by academic or government experts under rigorous scientific conditions. The data, therefore, are approximations of reality at best. Sloppy weighing, in particular, may well be a pervasive attribute.[20] Second, because all children in the sample were in the program in September 1977, longitudinally the weight and health data are most complete the more recently they were recorded, with attrition occurring as one moves back in time.[21]

Perhaps the biggest disappointment is the lack of a control group.[22] All children for whom we have data were in the CHDP, and we are forced back on

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[20]Furthermore, the process of transferring the data from questionnaire to computer requires the utmost care and, quite often, is the stage in data analysis where the most serious errors enter the data. In this case the effort to clean the data of both types of error took several more months and is described in Appendix XV. In general, when examining data of this kind it is prudent to question how serviceable to analytical use they really are. In the case of the Kottar data set we are satisfied that they are eminently serviceable.

[21]To illustrate, the number of sample children for whom weights were recorded in January 1977, omitting outliers, is 3,310. For January 1976, the number is down to 1,948; for January 1975, 793; for January 1974, 136; and for January 1973, 7. The principal reason is, of course, child age; older children in the program typically having been replaced by younger siblings and the youngest children not going back many months. Similarly, the villages themselves joined the CHDP in different years.

[22]When we began the coding, we thought that we did have a control group. KSSS was setting up the CHDP in the remote village of Kotoorconam in September 1977 but had yet to provide any services. At our request, the Kottar leadership agreed to a single wave of child weighing in Kotoorconam and to the gathering of family data as well. Unfortunately, as things turned out, child weights were secured without family data and family data without child weights, thereby negating the entire enterprise. Kotoorconam has been deleted from our file.

internal comparisons as a result.[23] Nevertheless, the data reveal considerable diversity in nutrition, health, family characteristics, living conditions, and social attainments. The 21 villages from which our sample was drawn may possess certain distinctive qualities (which is why they were selected), but together they would seem to cover the district, in its variety, quite well.

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[23]Experience suggests that reflexive controls utilizing duration of exposure are often at least as useful as formal control groups in a field setting. See Volume I of this series: William D. Drake, Roy I. Miller, and Margaret H. Humphrey, Final Report: Analysis of Community-Level Nutrition Programs (October 1980).

II. A DESCRIPTIVE OVERVIEW OF THE KOTTAR DATA: AGE FLOWS, TIME FLOWS AND CHARACTERISTIC CURVES

This section summarizes three ways to view the basic patterns of child growth in the data when these data are examined longitudinally.

First, we have created "age flows" at the sample, regional, and village levels. All children weighed at a particular age, expressed in monthly cohorts from the first month of life through the forty-eighth month, are counted regardless of when the weight was recorded.[24] In this manner, we can observe what Kottar children look like nutritionally in the course of their first four years, a time frame which includes the period of maximum vulnerability to malnutrition and infection and to infant and early childhood mortality.[25]

Second, we have created "time flows," again employing the village, region, and entire sample as units of analysis. Just as the age flows reflect all weighings of a particular monthly age without reference to the calendar, the time flows reflect all weighings recorded in a given month of a given year

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[24]Children between four and five years old also appear in the sample but in numbers too small to permit confidence in the results.

[25]Age flow data are without reference to calendar month or year. If a child was weighed at six months of age, his weight is included in the calculations no matter when that was. This analysis is based on the Harvard standards. Weights above 115 percent and below 50 percent of standard are treated as outliers are are omitted from the tabulations performed.

without reference to the age of the children weighed.[26] Children of all ages weighed in January 1975 may then be compared with the children of all ages weighed in January 1976, July 1977, or whenever. What the time flows display is how nutritional status among sampled children has varied over a three year period between September 1974 and August 1977.[27]

Third, we will combine the time and age variables to create a picture of change accounting for the two simultaneously. We call the resulting picture a characteristic curve and we will demonstrate how the curve is often a more helpful device for viewing patterns of child growth.

Age Flows

The extent of malnutrition among children served by the Kottar program is related to child age, but the pattern observed by this method differs from the usual age dynamic described in the literature.[28] Kottar children do not grow normally for the first four to six months after birth and then

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[26]The age of a child is incorporated into the time flows in the sense that all weights are expressed as a percentage of the Harvard standard for that age. Outliers, as previously defined, are again omitted.

[27]Measurements for children in the sample go all the way back to October 1972. However, the number of sample children weighed then, in 1973, and for much of 1974 remained too low to permit statistical disaggregation. September 1974 was the first month in which more than 400, or roughly 10 percent of sample children, were weighed.

[28]See, for example, Leonardo J. Mata, The Children of Santa Maria Cauque: A Prospective Field Study of Health and Growth (Cambridge: The MIT Press, 1978), notably pp. 278-9.

experience growth failure in spasmodic fashion over the ensuing two or three years as their bodies respond to health insults, inadequate supplementation of breast milk, and weaning. Nor do they reveal the catch-up growth often seen among children who have survived this early vulnerable period in their lives.

Instead, Kottar children exhibit a pattern of steady growth failure during the first year following birth. At 12 months the average child has "bottomed out" at 73 percent of normal weight-for-age (Harvard standards). Moreover, he stays at that level through his fourth birthday. In effect, he grows quite normally after the first year, only well below standard. No catch-up growth is evident in the data.[29]

This pattern characterizes both regions of the district--coast and interior--which, in fact, resemble each other closely in terms of their child growth profiles. It is also apparent in all 21 villages sampled. Not a single village conforms to the pattern typically found elsewhere.[30]

In sum, as shown in Figure 1, the average child in Kottar's CHDP plummets from being 90 percent of standard at age one month (following what would appear to be a reasonably adequate birth weight) to 73 percent of standard at age 12 months. Normal growth begins at that point and persists through the 48th month of life, the average child neither deteriorating further nor

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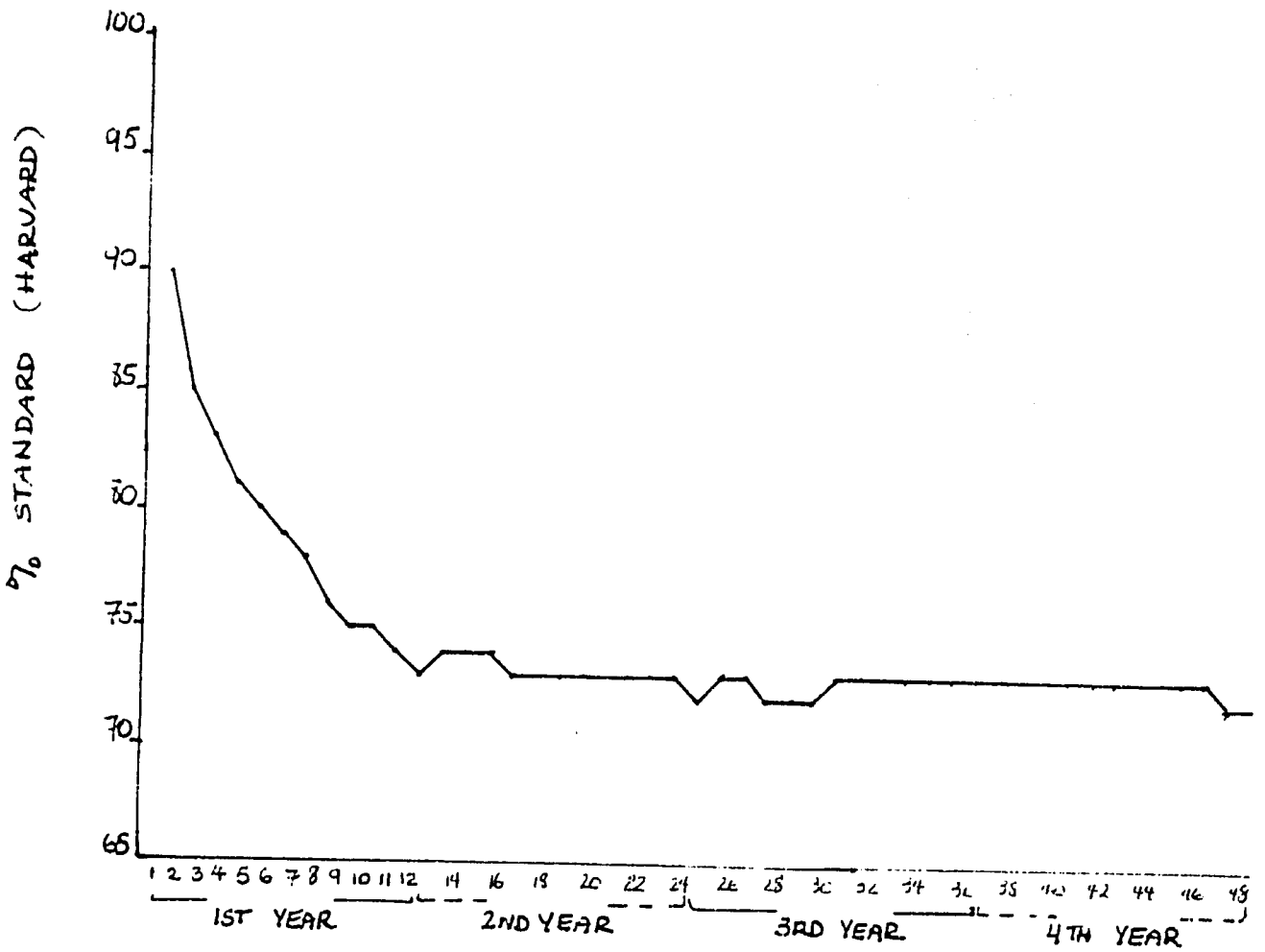
[29]As we shall note later in the text, the apparent lack of catch-up growth reflects our use of the Harvard standards. Relative to the less ambitious standards recommended by the Voluntary Health Association of India, Kottar children do reveal catch-up growth.

[30]See Appendix II.

FIGURE 1: AGE FLOW: AVERAGE PERCENT OF STANDARD (HARVARD), KOTTAR DATA
(Weight for Age)



Age by Month

improving relative to standard. Growth-wise, toddlers in the Kottar program are in a steady state when the Harvard standards are employed.

A similar message is conveyed by Table 2, which applies the Gomez classification to the Kottar data organized in selected monthly age cohorts. If 94 percent of the children weighed at one month are normal, only 4 percent are normal by age 12 months, an attrition which continues in the second year and which never really improves thereafter.[31] Third degree malnutrition increases from 0 percent to 8 percent over the first year of life and then

Table 2: Age Flow by the Gomez Classification of Nutritional Status at Selected Months, Kottar Data

Average Weight for Age as a Percent of Standard (Harvard)

Monthly Age	NORMAL 90.0+	FIRST DEGREE 75.0-89.9	SECOND DEGREE 60.0-74.9	THIRD DEGREE <60.0	(N)
1	94	3	3	0	(104)
6	21	42	32	5	(2,653)
12	4	40	48	8	(2,836)
18	2	36	55	7	(2,543)
24	1	37	55	7	(2,017)
30	2	31	60	7	(1,354)
36	2	35	55	8	(827)
42	1	34	59	6	(453)
48	2	33	58	8	(200)

Note: The percentage figures add to 100% horizontally (discrepancies due to rounding). Figures in parentheses refer to the number of children weighed at each monthly age shown. Weights above 115% and below 50% of standard have been treated as outliers and omitted from this tabulation.

[31]Using the classification scheme of the Indian Academy of Pediatrics (IAP), with its 80 percent cut-off between normal and malnourished, softens the attrition from normal growth, but the figures remain striking: 97 percent being normal at age one month, 25 percent at 12 months, and 19 percent at 24 months. Appendix III presents a complete display of the age data using the Gomez classifications, and Appendix IV does the same using the IAP classifications.

generally holds at that level subsequently. Second degree malnutrition mushrooms from 3 percent to 48 percent of the children weighed in the first year and builds to three-fifths of the children in the third and fourth years. When all is said and done, Kottar children quickly become pervasively and seriously malnourished on the age profile and then stay that way.

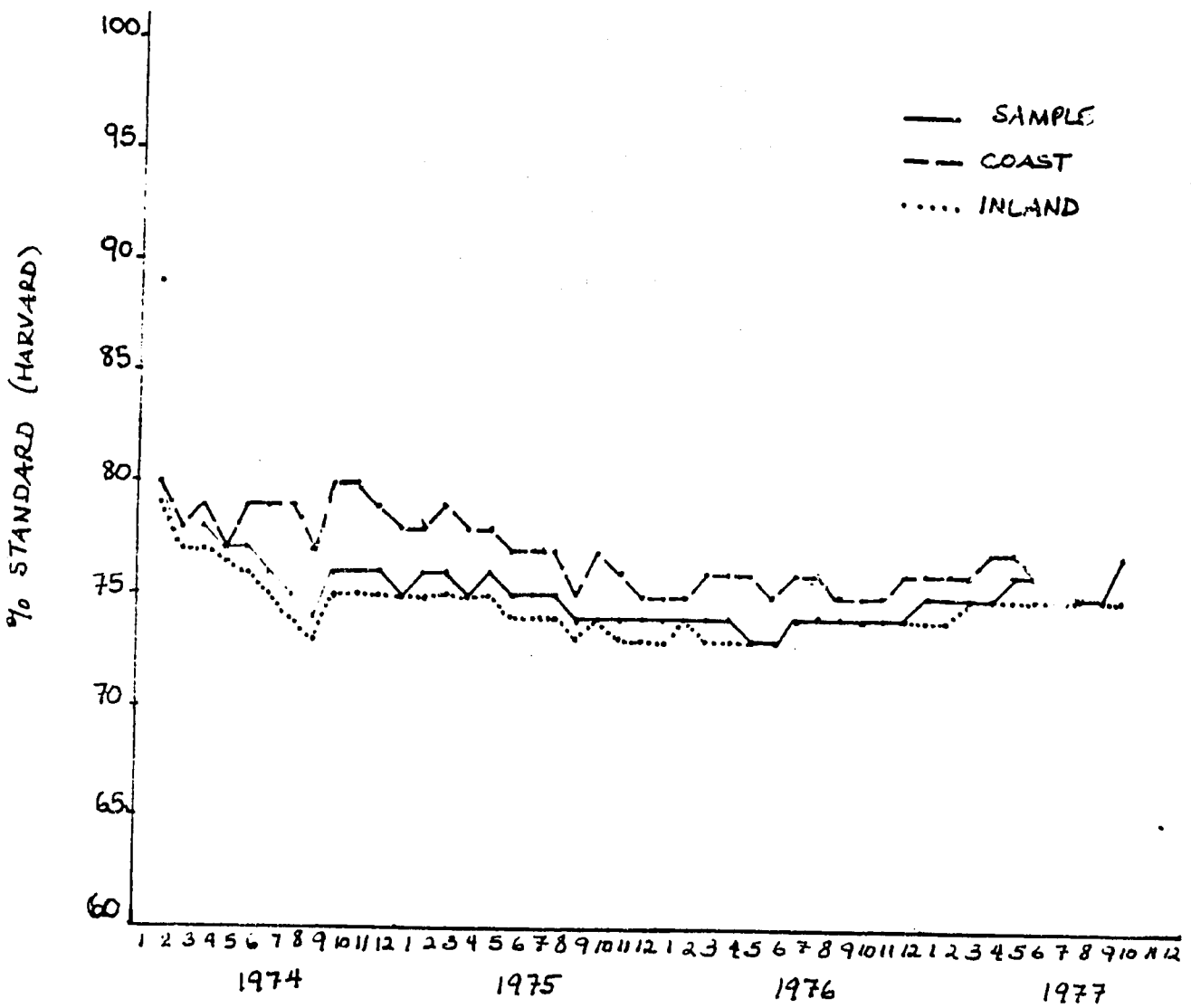
Time Flows

Reorganizing the data from age of the child (regardless of time) to time (regardless of age) produces several patterns of note.

One pattern is the remarkable uniformity that emerges when child weights are observed across the calendar, at least for the sample as a whole. No seasonal or annual variation in growth performance occurs when weight-for-age is used as a measure. Indeed, constancy characterizes the time flow, just as it does the age flow after the first year of life.

In the time flow, the greatest variation for any one year is only two percentage points (all weights having again been standardized as a percent of normal growth defined according to the Harvard standards). The greatest variation overall is a mere 3 percent between September 1974 and August 1977. Figure 2 shows that during this three year period, sample children in the Kottar Community Health Development Project weighed an average of 73-76 percent of standard. Rainy season, dry season, harvest season, lean season, too much or too little rain in the course of a year: nothing seems to matter. The children of poor rural families participating in the CHDP again appear to be in a steady state so far as their growth performance is concerned. Perhaps

FIGURE 2: TIME FLOW: AVERAGE PERCENT OF STANDARD (HARVARD) BY SAMPLE AND REGION, KOTTAR DATA (Weight for Age)



Years by Month

one of the effects of the CHDP has been to cushion children against negative changes in the environment.[32]

Another pattern is regional. The average child on the coast enjoys somewhat better nutritional status relative to his counterpart in the interior if our sample villages are typical. Given the image of fisherman families as being especially susceptible to hardship, this pattern is counter-intuitive.[33] On the other hand, the differences are small (although statistically significant at times), the widest disparity being 5 percent (in July, September, and October of 1974).[34]

Finally, as illustrated in Figure 3, there is substantial variation from village to village and even in the same village over time. That is to say, the sample and regional averages obscure a mobility, observed at the village level, which is quite striking. Four points may be made concerning this mobility. First, it reveals the extent to which short-term factors can be influential in characterizing the growth performance of children. Second, these factors appear not to be consistently related to seasonal or annual

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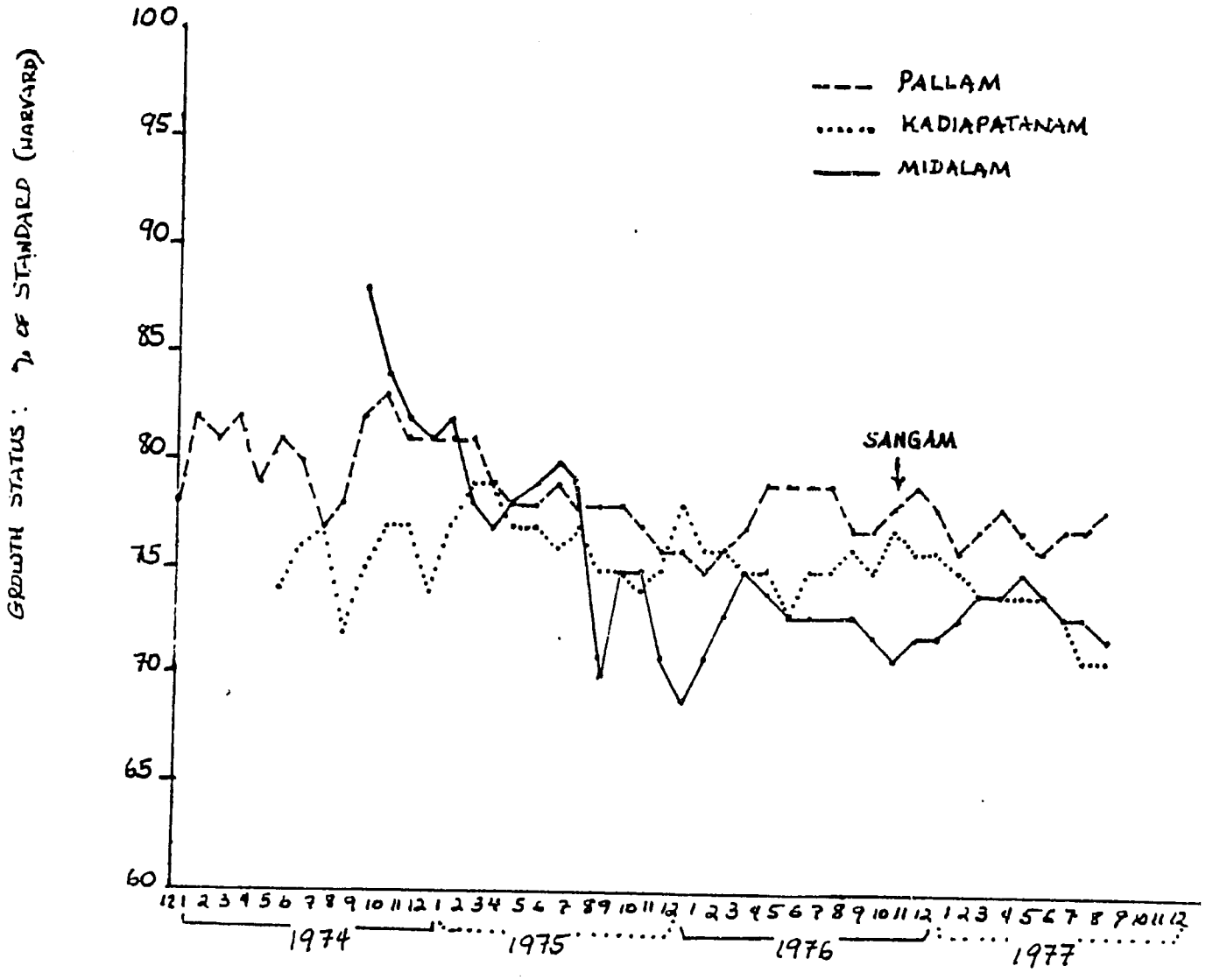
[32]Needless to say, in the absence of a control group this is speculation only. When disaggregated to the village level, the data do reveal the effects of drought in 1974 and 1975. Moreover, it is quite possible that the time flow for the sample as a whole masks positive change among the most at-risk children whose needs are disproportionately tended to by the CHDP. In the next section we shall see that the flatness of the time flow is a function of the "average percent of standard" measure of nutritional status. Alternative measures suggest considerable improvement in growth performance, especially between July 1976 and July 1977. See Figure 6 and Table 5.

[33]It is also contradicted by data presented in Section IV below indicating a higher incidence and greater severity of malnutrition on the coast. See Table 7.

[34]Regional comparisons on the time flows appear in Appendix V.

FIGURE 3: TIME FLOWS IN THREE COASTAL VILLAGES
(Weight for Age as a Percent of Harvard Standard, Kottar Data)



conditions. Third, much of the variation--but by no means all--occurs in the earlier years of the CHDP, when the data at our disposal are weaker. Fourth, analysis of variance suggests that differences across the villages, even within the same region, and differences across time are statistically significant. Knowing both the village in which a child lives and the month and year of measurement are, on balance, important pieces of information in predicting the growth performance of children in the Kottar program.[35]

Characteristic Curves

In the typical nutrition study--characterized by repreated cross-sectional samplings of the target population at different points in time--both the time flows and the age flows are quite useful. The peculiar characteristic of the Kottar program,which generated the time series data on the children restrospectively at a point in time, reduces the utility of these concepts.

As noted earlier, the sample covered participating children in July and August of 1977 for all ages. The time series of any one child was traced back to the time of entry of that child into the program. Thus, there are fewer observations on one-month-olds than two-month-olds and so on. The data for the early months in the age flow thus pertain to only a small subset of the sample while the data for the later months pertain to all children.

Similarly, the time flow is atypical in that not only does the number of children referred to at each successive point in time grow, but also the

[35]Appendix VI contains the average weight as a percentage of standard, over time, for each village in the sample.

age distribution at each point in time changes. The average age of children in the sample in July of 1976 was considerably less than the average age in July of 1977. (In July of 1976, only 36 children were over 42 months old; in July of 1977, 253 were over 42 months old.)

Note, in studies where all children in a village are included or a sample is drawn from all children at successive points in time, these problems do not arise. At each such point in time, the number of children of any given age is about the same (new births fill the youngest cohorts while "graduation" empties the oldest). Similarly, all ages are represented uniformly throughout.

The characteristic curve combines age and time and, though not a cure for the peculiarity of the Kottar data set, it does offer a way to understand its consequences. Table 3 presents the raw data from which the characteristic curve shown in Figure 4 was drawn.[36] This curve plots age of child against percentage malnourished for three different cohorts of children. A monthly tracking would be unwieldy using this format; therefore, we used six month intervals. Note that the changing age distribution as well as the changing sample size through time are obvious.

Table 3 also can be used to compare both age flows and time flows. Reading across a line, one can ascertain how an age cohort changed through time. For example, line one shows that 0 to 6 month-olds retained a near constant mean percentage of standard throughout--82.2 percent, 82.6 percent,

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[36]These data were prepared later in the analysis, after the NCHS-CDC standard had been applied to the raw data. This standard is sufficiently close to the Harvard standard that the shift is not troublesome.

TABLE 3

MALNUTRITION INDICATORS BASED UPON NCHS/CDC STANDARD, KOTTAR DATA

(Between January 1975 and July 1977)

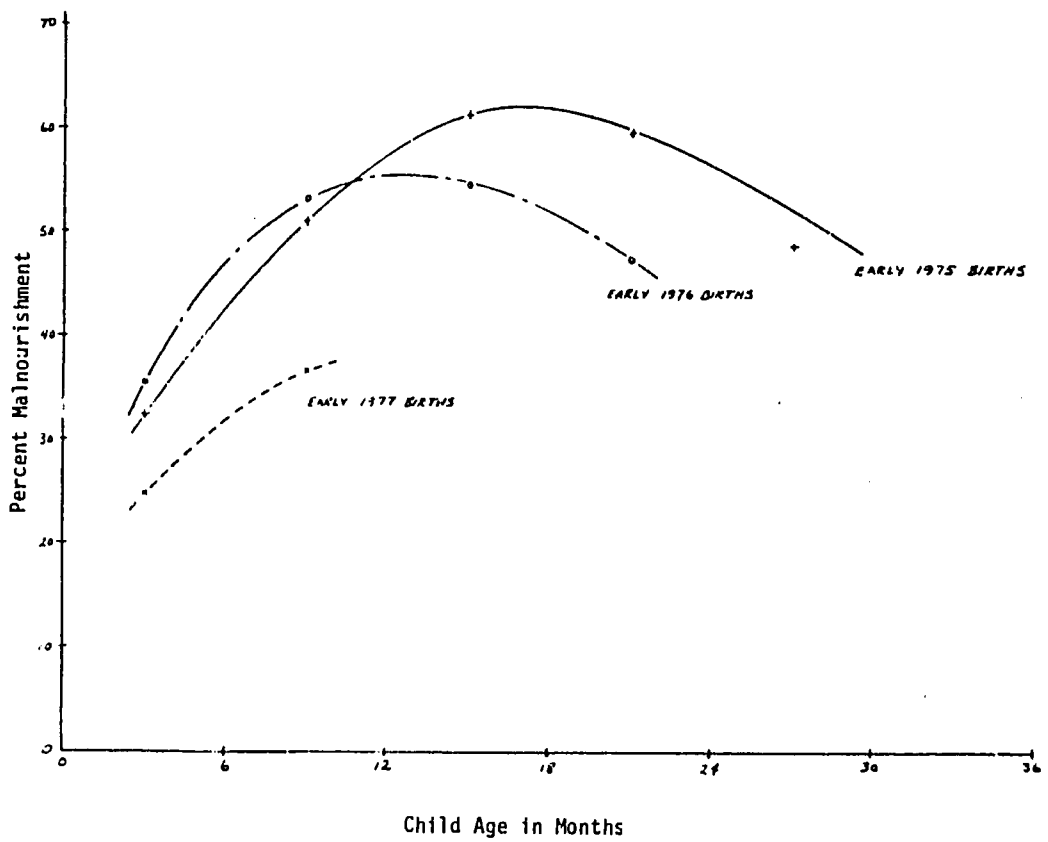
Child Age In Months	January 1975				July 1975				January 1976				July 1976				January 1977				July 1977			
	N	Mean %STD	%MAL	%III	N	Mean %STD	%MAL	%III	N	Mean %STD	%MAL	%III	N	Mean %STD	%MAL	%III	N	Mean %STD	%MAL	%III	N	Mean %STD	%MAL	%III
0 to 6	262	82.8	32.1	4.2	272	82.6	29.4	4.8	394	81.2	35.3	5.1	386	82.7	27.7	4.1	435	82.2	24.8	3.7	285	82.0	26.7	3.5
7 to 12	245	73.8	51.8	13.5	405	74.4	50.9	9.9	511	73.1	53.6	11.9	576	74.0	52.8	9.2	588	75.8	45.7	4.6	544	77.9	36.6	4.4
13 to 18	202	71.8	58.9	9.9	278	72.8	59.4	7.6	456	73.3	61.4	5.0	596	72.6	57.7	9.2	518	73.9	54.2	5.7	589	7[illegible].6	44.3	4.6
19 to 24	84	69.2	71.4	16.7	209	71.4	65.1	12.0	302	72.7	60.6	7.9	479	73.5	59.7	4.4	621	74.0	51.4	5.8	602	75.3	47.7	2.5
25 to 30	29	70.4	72.4	10.3	90	70.5	68.9	13.3	219	72.8	61.2	6.4	315	73.4	56.8	7.6	471	75.2	48.6	2.1	563	74.8	49.2	5.3
31 to 36	6	63.5	100.0	16.7	29	69.9	69.0	13.8	91	71.2	60.4	9.9	205	72.7	60.5	6.3	312	74.1	54.2	4.[illegible]	431	75.6	49.4	1.6
37 to 42	1	43.5	100.0	100.0	7	64.1	100.0	28.6	29	70.6	72.4	13.8	90	72.4	68.9	6.7	215	74.1	58.6	2.3	285	74.0	55.1	3.9
43 to 48					1	48.6	100.0	100.0	6	62.1	100.0	33.3	29	69.4	72.4	10.3	94	73.4	57.4	6.4	177	73.9	56.5	5.1
49 to 54									1	51.5	100.0	100.0	6	62.6	100.0	33.3	23	70.4	65.2	8.7	66	72.9	56.1	6.1
55 to 60													1	57.0	100.0	100.0	4	63.7	100.0	25.0	10	68.4	80.0	10.0
Total		75.5	50.4	10.0		74.8	52.4	9.1		74.5	54.4	7.9		74.5	53.4	7.2		75.5	48.2	4.5		76.0	45.5	3.9

Malnourished = Below 75% of Standard

III Degree = Below 60% of Standard

FIGURE 4 CHARACTERSITIC CURVE: MALNOURISHMENT vs: CHILD AGE

KOTTAR DATA USING NCHS/CDS STANDARD



81.2 percent, 82.7 percent, 82.2 percent, 82.0 percent. But 19 to 24 month-olds showed a steady improvement 69.2 percent, 71.4 percent, 72.7 percent, 73.5 percent, 74.0 percent, 75.3 percent.

By reading across the table and dropping one line at each time period, one can follow a single set of children through the aging process.[37] In this way, we can see the commonly accepted notion of an age of peak risk. Following the first group, at 0-6 months the percent malnourished was 32.1 percent; 7 to 12 months, 50.9 percent; 13 to 18 months, 61.4 percent and so on. A similar but more pronounced characteristic is evident when children with grade III malnourishment are observed.

These patterns are more consistent with our expectations--we see improvement in the "at risk" age groups over time and we see that a single set of children moves through a period of maximum risk and then shows signs of subsequent improvement.

Which approach is most useful? Age and time flows have the merit of simplicity and generally require less data to utilize. On the other hand, characteristic curves do not permit aggregate changes over time to become confused with changes due simply to aging. Furthermore, the same cohort of children can be observed over time and compared with other cohorts, thereby permitting additional analysis. We therefore favor use of the characteristic curves approach in most instances.

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[37]Observations for plotting characteristic curves were obtained in this manner.

III. KOTTAR'S IMPACT ON MALNUTRITION

One might think that a program as well managed as Kottar's Community Health Development Project would show clear signs of benefitting the malnourished children it serves. Food supplements are distributed fortnightly, at which time appropriate nutrition-health lessons and simple health care are imparted as well. The children are weighed every month, while home visits, innoculations, and referral occur when necessary. Beginning in 1977, the mobile health teams were replaced by permanent teams running "health cooperatives" in each village, a shift designed to intensify and broaden interaction with the CHDP's intended beneficiaries. With participation rates being as high as they are, Kottar represents an important test of what happens when a service-delivery program having considerable outreach functions effectively in its environment and achieves a high degree of sustained contact with small children (and their families) in the villages. Add to these qualities the many other activities with which KSSS is engaged in Kanyakumari District, and the opportunity for assessing impact looks most promising indeed, even in the absence of a control group.

Our discussion begins with comparisons of children in the CHDP as they differ according to their age of entry and length of time in the program. We then address village data, first by comparing the growth performance of children living in villages which have and have not been complemented by other

KSSS inputs and then by examining individual villages over time to assess the effects of specific programmatic innovations occurring in them. We conclude by assessing the validity of explanations for nutritional improvement other than Kottar's own impact.

Theoretically, an intervention's impact on malnutrition should be conditioned by the age of the child, the child's age of entry into the program, and the length of time that the child remains in the program. It is reasonable to infer that an intervention's impact will be greatest during the period of maximum vulnerability to malnutrition and infection, when assistance may be expected to help cushion the effects of insult most. It is also reasonable to assume that the earlier a child is reached by an intervention, the better the prospects for successful impact. Finally, impact may be a threshold phenomenon which is not observable until a certain amount of remedial attention has been provided.

All three notions can be tested with the data at hand, the Kottar experience being particularly appropriate for such tests. Not only has the CHDP achieved wide coverage, it reaches the target groups early. Three-quarters of sample children entered the program in their first six months of life, with 90 percent having done so by the end of their first year. Once registered in the CHDP, children tend to remain in it for a fairly long period of time, the average duration being 20 months. Participation, as measured by weight entries on growth charts, is an impressive 96 percent.[38] Accordingly,

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[38]To be more precise, participation is measured as the number of monthly weight entries on a child's growth chart as a percentage of the total time, also recorded in months, that the child has been registered in the CDHP. As

we have made detailed comparisons of children of different ages, ages of entry, and time in the program--individually and in combination--using weight-for-age as a percentage of standard (Harvard) as the measure of nutritional status.

Granted that this measure--like others--might tend to understate improvements in nutritional status, the results are disappointing. We can find no evidence of change, much less impact. Malnutrition may reflect age, as seen in the age flow and characteristic curve (Section II above), but the CHDP shows no sign of arresting or otherwise interfering with the age dynamic. Age of entry makes no difference; nor does length of time in the program. Saddest of all, children of a particular age who have been in the CHDP for varying durations, including all their young lives, are no better off than are children of the same age just entering the program. The impression conveyed is that membership in the CHDP, even long-term membership, is unassociated with improved nutritional status notwithstanding all the services provided.[39] Table 4 presents a summary distillation of the relevant data.[40]

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impressive as the sample average are the median (99.7 percent) and the mode (100 percent). In most instances there is virtually no difference between duration and participation in the program.

[39]It is possible that the patterns observed and inferences derived from them might differ depending on the measure of nutritional status employed. There is a clear need for further analysis along these lines.

[40]Table 4 is unaffected by isolating children who entered the CHDP at one month of age and who remained in it for 18 months or more. See Appendix VII for the complete age by age-of-entry matrix. As might be expected from Table 4 and Appendix VII, there is hardly any correlation between growth performance and length of time in the CHDP when child age is held constant. Nor do scattergrams reveal any threshold effects.

Table 4: The Apparent Lack of Nutritional Impact, Kottar Data

	----------Average Percent of Standard (Harvard)----------		
	All Sample Children	Children in the CHDP Since Their First Month of Life	Control Group: Children Who Entered the CHDP at the Age-Month Indicated
6 Months of Age	79%	79%	80%
	(2,771)	(462)	(211)
12 Months of Age	73%	74%	75%
	(2,819)	(388)	(114)
18 Months of Age	73%	73%	75%
	(2,437)	(302)	(31)
24 Months of Age	72%	72%	73%
	(1,910)	(232)	(24)

Figures in parentheses refer to the number of children in each cell.

Note: Data reflect growth performance as measured by weight-for-age measurements expressed as percentages of the Harvard standards.

CHDP refers to the Community Health Development Project.

If the CHDP shows no statistical sign of benefitting the children enrolled in it when the children are compared with one another, much the same is true when the growth profiles of children in sample villages are compared. One village (Kulasekaram) was selected for inclusion in the study because, aside from the CHDP, no other KSSS-sponsored activities have taken place in it. The same turns out to be true of three other villages (Vattam, Konamkadu, and Palliady). These four villages are "pure" examples of service-delivery in the absence of attempts at broader socioeconomic change.

By contrast, two villages were included in the study precisely because KSSS has made a range of inputs in them. En. Puthenthurai, on the coast, received a considerable amount of food-for-work in 1974 to permit construction

of resettlement housing. A fisherman's sangam was established in the autumn of 1976, and En.Puthenthurai also has one of the nylon net-making centers established under Kottar auspices. Parakunnu, in the interior, has featured even greater activity, from housing schemes, road building, and well digging on a regular basis over several years to formation of a palmyra climbers' association, organization of several cottage industries, and creation of a health cooperative (in July 1976). As headquarters for Kottar's channel irrigation project, Parakunnu has also benefitted from the channel digging and land reclamation sponsored by the project.[41]

En.Puthenthurai and Parakunnu are examples of a more comprehensive approach to change that goes beyond service delivery to include employment generation, environmental engineering, and improved economic participation by especially backward, even oppressed members of society (fishermen and palmyra climbers). Two additional villages (Mel-Manakudy and Thirumalai) are also notable for having received intensive attention from the Kottar Social Service Society.

If one believes that nutrition interventions are most likely to attain nutrition goals when they are complemented by other inputs addressed to structural constraints and the competitive position of the poor in local decision-

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[41]Parakunnu has probably experienced more in the way of guided change than any other village in the sample (or district). The Executive Director of KSSS served as a parish priest in Parakunnu for 20 years, and it was very much on the strength of his efforts there that the Kottar Social Service Society was founded. The current parish priest is himself on the KSSS Executive Board. In addition to the activities noted in the text, Parakunnu has a palmyra straw--palm fibre cooperative, a facility to boil palmyra juice down to "jaggery" (a candy-like food which is sold in the market), and a milk cooperative society that, in 1979, owned six cows.

making and marketing arrangements, then En.Puthenthurai, Parakunnu, Mel-Manakudy, and even parochial little Thirumalai[42] might be expected to show improved patterns of child growth relative to the several villages lacking multiple stimuli to community development and social change.

This expectation is not sustained by the village profiles, however. The average child in the multiple-input villages possesses a growth performance which is not better than the average child in the CHDP-only villages. That there is little to choose between the two sets of villages says little in and of itself. More to the point is the fact that the average child in the multiple-input villages gives no evidence of greater improvement over time relative to the average child in the CHDP-only villages. The time flows (Appendix VI) reveal considerable heterogeneity among the villages in question but a heterogeneity which fails to sort out in the predicted manner. To illustrate, En.Puthenthurai, the coastal village referred to above in which KSSS has been especially active within the past decade, actually features a steady decline in the average child's nutritional status between August 1975 and August 1977 (see Figure 5). Moreover, any presumption that the children of multiple-input villages might have been cushioned against the effects of the extended drought of the mid-1970's by virtue of KSSS-inspired innovations in their midst is similarly incorrect. If the ravages of drought are detectable in the CHDP-only villages, they are equally evident in the multiple-input villages.

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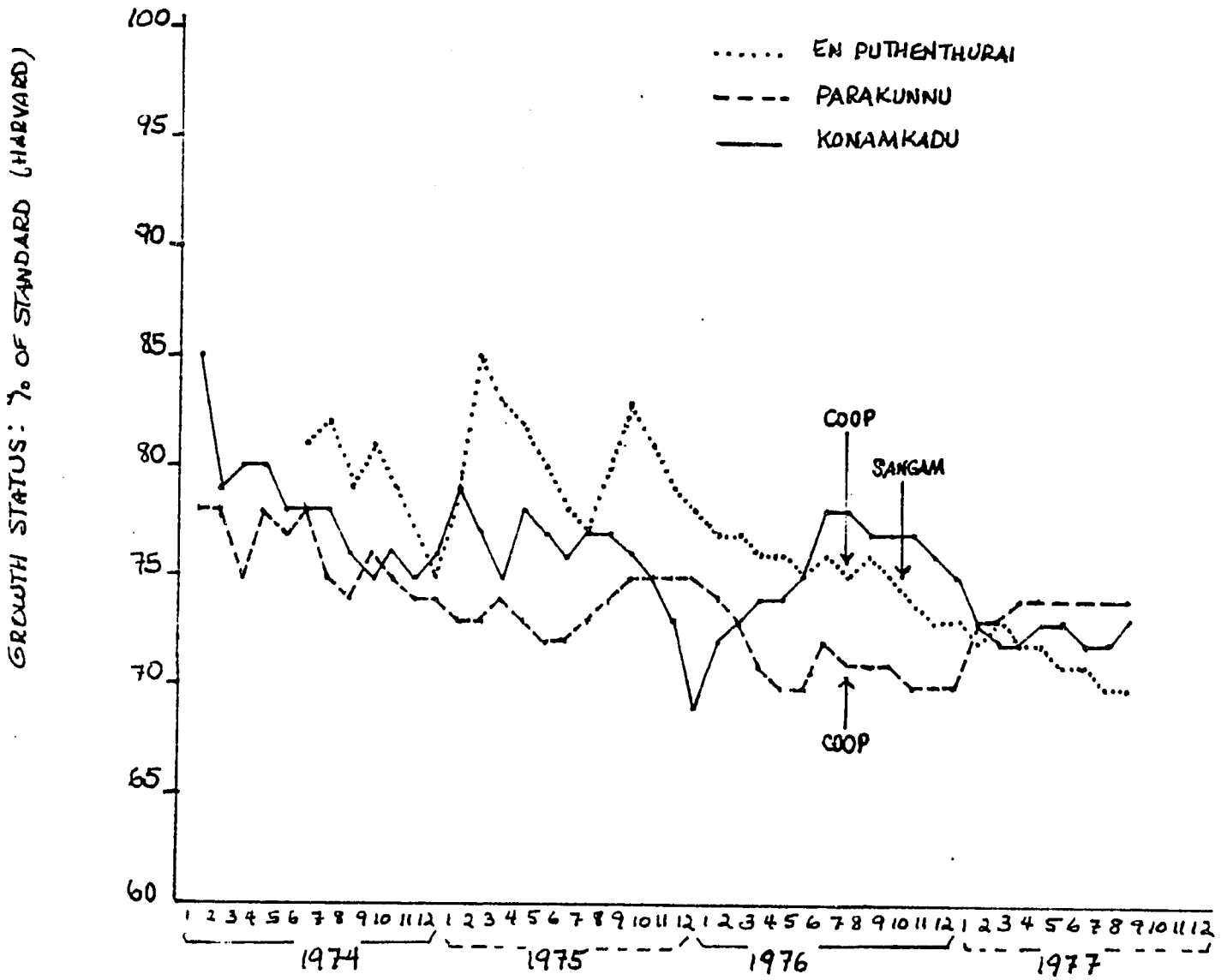
[42]Thirumalai is discussed in Field, op. cit. See also note 43 below.

FIGURE 5: TIME FLOWS IN TWO MULTIPLE-INPUT VILLAGES (EN. PUTHENTHURAI AND PARAKAUNNU) AND ONE CHDP-ONLY VILLAGE (KONAMKADU) (KOTTAR DATA)



In sum, the village comparisons that we have been able to make provide no clear confirmation of the benefits to child growth that theoretically follow upon a broad-gauged community development approach as against a single-shot health/nutrition intervention approach. The evidence is not very conclusive either way, although the lack of contrast is much the clearer message. Figure 5 presents the time flows for En.Puthenthurai and Parakunnu, two of the villages noted above that have enjoyed multiple Kottar initiatives, in comparison with Konamkadu, a rather representative village of small farmer families in which the Kottar presence has been confined to the CHDP.

If, as illustrated in Figure 5, the multiple-input villages differ little from the CHDP-only villages in the ways described, perhaps it might still be possible to attribute success in alleviating malnutrition to certain inputs within specific villages. Of the many activities sponsored by KSSS in the district, we have time-of-origin information on two: the creation of health cooperatives and the formation of fisherman sangams. The health cooperatives are an adaptation of the CHDP introducing a permanent health-team presence in participating villages. The sangams are organizations of younger fishermen designed to bypass moneylenders, develop alternative marketing outlets, overcome indebtedness, acquire mechanized boats, and--in general--improve the terms of trade through collective action. There is every reason to believe that both the sangams, indirectly, and the health cooperatives, directly, might be associated with improvements in nutritional status.

Once again, the evidence is not encouraging. Four of the seven coastal villages in our sample had joined the sangam movement before the data were gathered. Not one of them displays a shift upwards in nutritional status

as a result of having done so. Twelve of the 21 villages in the sample had introduced health cooperatives in 1976 (and January 1977). In half of these villages the slope (average weight-for-age as a percentage of standard over time) remained the same or declined. In five villages the slope improved initially--or after a brief lag--only to decline later on. Whether the improvements can be attributed to the health cooperatives is problematic given the fluctuations observed, especially inasmuch as comparable improvements in 1976 and 1977 occurred in villages without cooperatives. Only in Palliady, a village inhabited by weavers in the western plateau of the district, does the creation of a health cooperative clearly seem to trigger a marked improvement in growth performance. Between January 1977, when the cooperative was established, and August 1977, the last month for which we have data, the average child in Palliady went from 71 percent to 78 percent of standard, the most dramatic gain of any village during that period.

Tests of this kind are, of course, highly inferential. Even in the case of Palliady we really do not know whether or to what extent the health cooperative there was responsible for the nutritional improvement achieved. Problems of attribution aside, the fact of the matter is that actual evidence of improvement in relation to such innovations as the cooperatives and sangams is so limited and generally unconvincing that it is not possible to claim much on their behalf. Indeed, if the children of Palliady (along with those of Thirumalai)[43] show signs of responding well to KSSS initiatives,

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[43]Thirumalai children have benefitted from Kottar's many activities in this depressed village of potters and landless Harijans. The CHDP in Thirumalai has been complemented by a potters' cooperative, construction of new potters' sheds and kilns and more advantageous marketing of their pots, a

En.Puthenthurai and Parakunnu (Figure 5) demonstrate how potent the barrier can be between broad-gauged socioeconomic improvement even with the targeted delivery of health-nutrition services, on the one hand, and nutritional improvement in preschool-age children, on the other. Its impressive achievements notwithstanding, as of 1977 Kottar appears not to have replicated the nutritional successes of neighboring Kerala or Sri Lanka.[44]

Our findings, although disappointing, are too limited to be more than suggestive. In fact, the Kottar data set confirms what we have observed elsewhere, that the likelihood of documenting nutritional improvement over time depends on the standards of normal growth employed.[45] With the Kottar data, the choice of standards is critical. As seen in the time flow for the sample as a whole, the Harvard standards (on which we have relied thus far) indicate no nutritional improvement from 1974 into 1977, implying--in the absence of a control group--a general lack of impact. The reason, revealed in the age flow, is that Kottar children between 12 and 48 months of age grow

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resettlement housing scheme for the Harijans featuring electrification and much improved sanitation, cottage industries, and a kresch for children whose mothers are working on KSSS projects. Thirumalai is also the operational headquarters of KSSS and the home of the Executive Director and the head of the CHDP. In response, Thirumalai children served by the CHDP have gone from an average weight-for-age of 68 percent of standard (March 1975) to 77 percent of standard (August 1977).

[44]See, for example, Davidson R. Gwatkin, "Food Policy, Nutrition Planning and Survival: The Cases of Kerala and Sri Lanka," Food Policy, 4 (November 1979), 245-258, and John W. Ratcliffe, "Poverty, Politics and Fertility: The Anomaly of Kerala," Hastings Center Report (February 1977), 34-42. In fairness to the Kottar program, our methodology tends to raise a more complete array of competing explanations for change in nutritional status than is usually advanced. See Drake, Miller and Humphrey, op. cit.

[45]See Drake, Miller, Humphrey, op. cit.

parallel to the Harvard growth curve, only well below it. When the more lenient standards of the Voluntary Health Association of India are used instead, Kottar children do show some aggregate improvement as they become older. Possible explanations for this improvement, CHDP impact included, are considered below.

Not only is the selection of growth standards important. Equally important, if not more so, is the choice of indicators of nutritional status. One problem with the average percent of standard, on which we have relied so heavily in our assessment of impact, is that when applied to the Kottar data, it yields only the most marginal changes over time and across socioeconomic categories.[46]

By contrast, two other measures of nutritional status--the percent malnourished (really the percent below 75 percent of standard) and the percentage third degree--are far more variable in their manifestations. This may be seen in Figure 6, which plots all three indicators across six time periods between January 1975 and July 1977, along with the retail price of rice in Kanyakumari District in the same six periods. Two things are immediately apparent. First, the percentage of children who are malnourished and the percentage of those experiencing third degree malnutrition varied considerably, whereas the average percent of standard did not. Second, were one to relate the price of rice to the average percent of standard alone, one would conclude--erronously--that there could be no relationship. The other two indicators suggest that the price of rice and malnutrition are, in fact, quite

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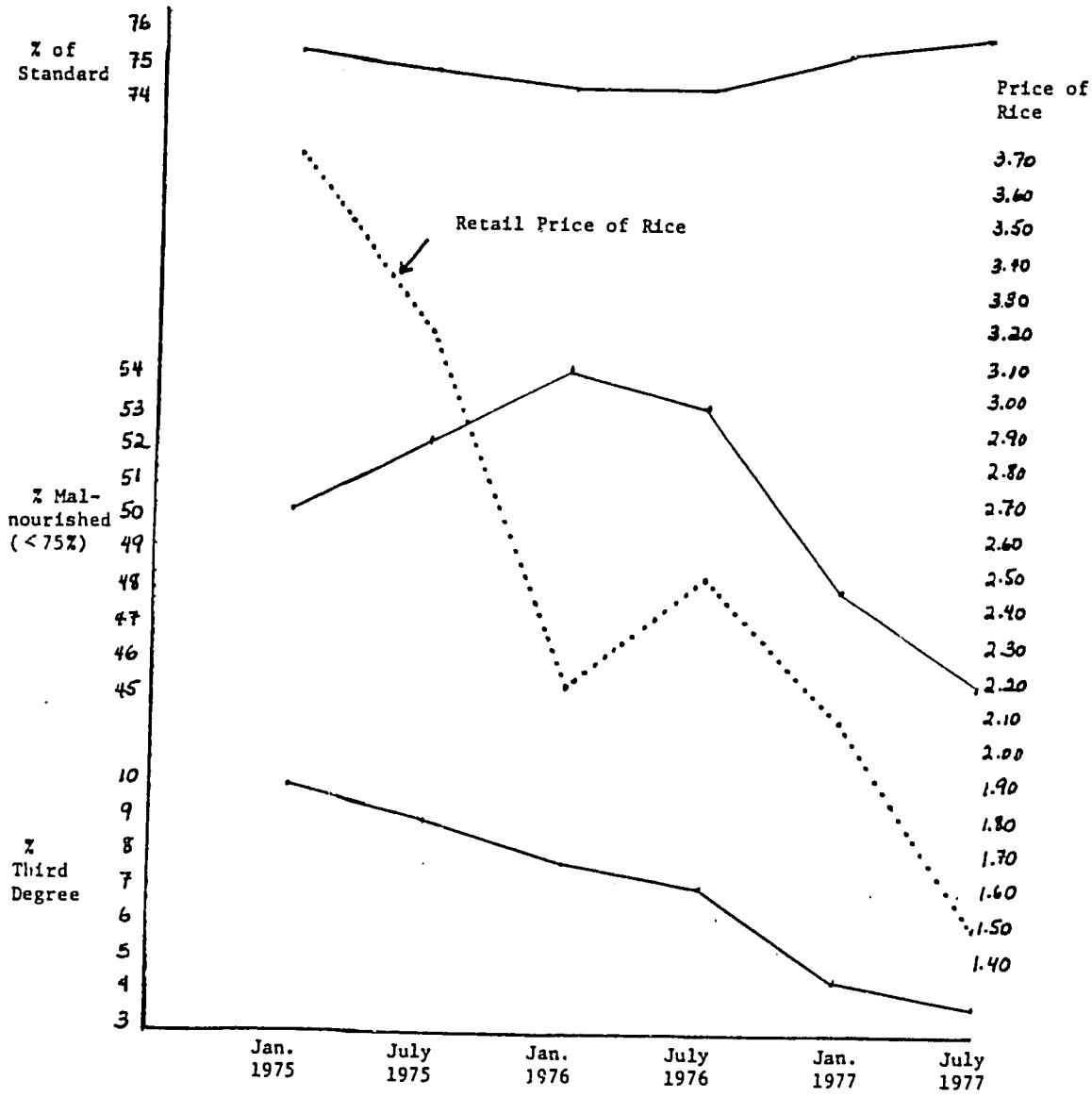
[46]See the time flow (Section II) and the data reported in Section IV for evidence of this effect.

FIGURE 6: VARIATION OVER TIME IN NUTRITIONAL STATUS AND THE PRICE OF RICE, KOTTAR DATA



Note: The NCHS/CDC Reference Medians inform the three indicators of nutritional status plotted in this figure.

closely related and that significant decline in both occurred between January 1976 and July 1977.[47] This being the case, it is entirely possible that the CHDP and other Kottar inputs have had an impact on the incidence and severity of malnutrition which so bland a measure as average percent of standard (regardless of the standard) simply obscures.

We now turn to the question of attempting to explain the improvement in growth performance over time. Four competing explanations can be offered.

1. Newcomers to the program (new births, in-migrants, and other new participants) were better off than children who were in the program at the start.

2. The observed improvement reflects the normal recovery from malnutrition associated with aging.

3. A drought, which caused rice prices to peak in January 1975, caused malnutrition to peak at about the same time, and the improvement in nutritional status is due to recovery from drought.

4. The improvement in growth performance is due to the CHDP and other KSSS activities. That is, the program worked.

The first explanation fails to stand up under statistical inquiry, if only because the relative number of newcomers over six months of age is small. Moreover, the difference between newcomers and longer-term registrants in the CHDP is also small. In general, newcomers are no less likely to be malnourished than children already in the CHDP. Their presence does not account for the improvement observed.

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[47]The association between the price of rice and the percent malnourished may be even stronger than Figure 6 implies. The price of rice had risen dramatically in 1974 to the high shown for January 1975. The increasing malnutrition observed in 1975 is probably a lag effect reflecting cumulative toll. That the incidence of third degree malnutrition declined in 1975 (from 10 percent to 8 percent) as the price of rice also declined may mean that the initial impact of shifting prices for a dietary staple is on the most nutritionally deprived. Appendix VIII presents the retail price of rice in Kanyakumari District as it varied monthly between 1973 and 1978.

The second explanation fares poorly as well. The improvement is not a function of aging; as indicated in Table 3, it is seen even among younger children.

Table 3 and Figure 6 document the improvement which comes to light when indicators of nutritional status other than average percent of standard are employed. The contrast is so striking that we have summarized the actual statistics in Table 5.[48] As can be seen, even though no significant change occurred in the average percentage of standard between January 1975 and July 1977, the percentage of children in the Kottar sample experiencing malnutrition did decline from 54 percent to 46 percent between January 1976 and July 1977, while those with third degree malnutrition declined from 10 percent to 4 percent over the two and one-half year period shown. These gains are not trivial, and we have two remaining explanations for them.

Table 5: Nutritional Improvement as Measured in Three Different Ways, Kottar Data

	January 1975	July 1975	January 1976	July 1976	January 1977	July 1977
Average % of Standard	75.5	74.8	74.5	74.5	75.5	76.0
% Malnourished	50.4	52.4	54.4	53.4	48.2	45.5
% Third Degree	10.0	9.1	7.9	7.2	4.5	3.9
Number of Children	829	1,291	2,009	2,683	3,381	3,552

Note: % Malnourished means below 75% of standard. All figures are based on the NCHS/CDC reference medians for weight for age.

[48]The data in Table 3 and Figure 6 reflect the new NCHS/CDC reference medians, which closely resemble the Harvard standards.

The third explanation, attributing the improvement in nutritional status to recovery from drought conditions which doubled the price of rice (from Rs. 185 to Rs. 370 per kilo) between February 1974 and January 1975, is supported by the data. The decline in second and third degree malnutrition in 1976 and 1977 has been documented in Figure 6. One can see that the decline roughly parallels the drop in rice prices during that time. In Kanyakumari District, as elsewhere, malnutrition gives every sign of being responsive to macro ecological and economic circumstances.[49]

The fact that the improved nutritional status among Kottar children in 1976 and 1977 is not accounted for by distinctive nutritional attributes of new entrants into the program during these years nor by age differences that would bias the results means that the improvement is real. The fact that the improvement parallels the general drop in rice prices which occurred after January 1975 is not surprising; in some ultimate if usually vague sense, nutritional status does reflect environmental conditions. The possibility remains, therefore, that the improvement reflects KSSS inputs as well.

This possibility is strengthened by the mortality records kept by the CHDP, crude as they may be.[50] The rates of infant and early childhood

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[49]The association is actually better than Figure 6 implies. Using the VHAI standards rather than the NCHS/CDC reference medians 1) reduces the incidence of malnutrition significantly among children over 3 years of age if modestly for the sample as a whole (the sample being predominantly young) and 2) causes the malnutrition to remain constant rather than to increase during the second half of 1975, when prices were dropping.

[50]Information on deaths in participating families is second-hand, if dependably obtained each year. It comes from interviewing mothers individually at clinic time. The Kottar leadership regards its data on mortality to be suggestive but not totally accurate.

mortality in the families of sample children are extremely low, suggesting that the CHDP has at least managed to keep vulnerable children alive.[51] Moreover, En.Puthenthurai, Parakunnu, and Thirumalai--three multiple-input villages in which KSSS involvement has been intensive--have among the lowest rates of early childhood mortality of the 21 villages in the sample. In fact, marked decreases in mortality occurred in En.Puthenthurai and Parakunnu between 1975 and 1977 (despite hardly any improvement in nutritional status in Parakunnu during this period and an actual drop of major proportions in En. Puthenthurai) in contrast to very much more marginal declines in childhood mortality in most other villages and the sample as a whole.

The implication of these patterns is that the CHDP has been effective on its own and that other Kottar initiatives have contributed to the survival of children as well. Indeed, the possibility arises that, through the CHDP and other initiatives, KSSS has achieved greater success in reducing childhood mortality than in alleviating malnutrition. If this is so, Kottar fits into the same pattern of accomplishment documented by several research projects, mortality being impressively responsive to intervention and malnutrition being notably resistant.[52] On the other hand it may simply be that the difficulty in showing positive nutritional changes is more due to the inherent under-

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[51]In 1977, a total of 162 deaths occurred among the 9,000 children covered by the CHDP in the 21 sample villages, a mere 1.8 percent. The 1975 and 1976 proportions are only marginally higher: 2.3 percent.

[52]Gwatkin, Wilcox, and Wray, op. cit., and Kielmann, Ajello and Kielmann, op. cit.

reporting associated with such a difficult-to-measure indicator as nutritional status.[53]

The issue of nutritional impact is not settled by any means; but the preponderance of analytic evidence indicates that the reduction in malnutrition is due to an improved environment which resulted either from the CHDP or more accessible rice or both.

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[53]Drake, Miller, and Humphrey, op. cit.

IV. THE DETERMINANTS OF NUTRITIONAL STATUS

The wealth of information present in the Kottar data set makes it possible to relate malnutrition to a wide range of social and economic characteristics. This section of the monograph puts the malnutrition of Kottar children in context, first by exploring the patterns of life and livelihood with which it varies and then by determining which of these influences best explain the differences in nutritional status that exist. The many variables examined are listed in Figure 7.

For purposes of this inquiry, we have detailed nutritional status in three ways:

- The average child's weight-for-age as a percentage of standard (NCHS/CDC);[54]
- The percentage of children whose weights are below 75 percent of this standard, hereafter referred to as the "percent malnourished";[55]

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[54]Our multivariate analysis employs the VAHI standards of normal growth as represented on the growth charts used in Kottar's Community Health Development Project.

[55]Seventy-five percent of standard is the customary cut-off point distinguishing first from second degree malnutrition. The statistical definition of first degree is a matter of some dispute, as is the validity of calling children in first degree malnourished in the sense of functional impairment. In any event, 75 percent on the NCHS/CDC standards approximates 80 percent of the VHAI standards, while use of 80 percent as the division between normal growth and malnutrition is increasingly common because it is quite close to the third percentile. Our use of 75 percent (NCHS/CDC) is, therefore, a reasonable cut-off point as well as a statistically convenient one in terms of dividing the Kottar sample roughly in half.

Figure 7 : Determinants of Nutritional Status: Organization of the Kottar Data Set

LOCATION

Region
Village

CHARACTERISTICS OF THE CHILD

Sex
Age
Birth ranking
Birth spacing
Health
Immunization record

SOCIAL CHARACTERISTICS OF THE FAMILY

Religion
Caste
Education
Mother's age
Family size
Family type: nuclear/joint
Number of pregnancies
Number of living children
Childhood mortality

ECONOMIC CHARACTERISTICS OF THE FAMILY

Occupation
Income
Ownership: land/animals/boats, etc.
Type of house
Water
Sanitation
Food expenses as % of income
Food expenses as % of total expenses
Indebtedness
Savings

CHANGES IN ENVIRONMENT*

Price of rice
Kottar activities

*analyzed in Section III

- The percentage of children experiencing third degree malnutrition (a weight-for-age of less than 60 percent of standard).

Each measure addresses a somewhat different aspect of malnutrition. The percentage malnourished reveals the overall incidence of malnutrition in the sample and permits analysis of why some children are more likely to be malnourished than others. The percentage of standard identifies the relative departure from normal growth experienced by the average child, while percentage third degree focuses on the incidence of severe malnutrition. In July 1977, the time when the nutritional data examined were derived, 45.5 percent of the children in Kottar's CHDP were malnourished; the average child weighed 76.0 percent of standard; and 3.9 percent of the children were in third degree.[56]

In preparing our analysis of these three indicators of nutritional status in relation to the socioeconomic variables listed in Figure 7, we examined the sample as a whole and then isolated out children in the 6-24 month age cohort, that period of most acute vulnerability to infection, malnutrition, and mortality. Many analysts might expect to find more malnutrition and more severe malnutrition in this cohort and consider it likely that those social, economic and health attributes disposing to malnutrition generally would do so with special virulence during this period.

Such expectations would be wrong on both counts. Children aged 6-24 months emerge as no more malnourished on the average than the rest of the

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[56]These figures pertain to sample children, of whom there were 3,556 after cleaning of the data. July 1977 was chosen for analysis because it is the monthly time period with the largest number of observations and also because most of the family history and socioeconomic data were gathered then.

sample, regardless of indicator. Moreover, the patterns of nutritional change across categories of the different variables examined are much the same. Inasmuch as there is no point in belaboring the 6-24 month cohort, we have omitted it in this presentation.[57]

Before highlighting the substantive findings obtained from bivariate analysis, we should like to report another pattern in the Kottar data which may intrigue analysts interested in the social and economic ecology of malnutrition. The three measures of nutritional status employed here do not always tell the same story. If the percentage malnourished and percentage third degree observed in the sample differ across social strata and other distinctions--at times impressively so, the same is not true of the average percentage of standard. In the Kottar data set, at least, this last indicator typically shows very little movement in the face of powerful differences in circumstance. Table 6 provides an illustration. It is clear that one's assessment of how malnutrition varies with other attributes will be influenced

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[57]It is tempting to attribute the similarity of the 6-24 month age cohort with the rest of the sample to the cushioning effects of the CHDP on children at greatest risk of growth failure. This may well be the case, although in the absence of a control group we cannot assess the validity of such a proposition. Other explanations can be advanced, however, on the strength of the data. As suggested by the age flow presented in Section II above, Kottar children aged 0-6 are the least malnourished, while those 25 months of age and above are actually more malnourished, on average, than are children in the 6-24 month cohort, which includes children still in decline as well as those who have bottomed out. Since there is no catch-up growth after children have left the vulnerable period, the 0-6 and 25+ groupings cancel each other out, in effect, and together resemble the 6-24 month cohort. This, in turn, is a function of our use of the NCHS/CDC growth standards, which like the Harvard standards employed in the age flow, reveal no growth recovery relative to standard among older Kottar children (on average). By contrast, use of the VHAI standards does yield evidence of catch-up growth; and we suspect that had our analysis in this section been based on the VHAI standards, the 6-24 age cohort would have appeared nutritionally distinctive.

by one's choice of a nutrition indicator even within the narrow range of possibilities afforded by weight data alone.[58] In general, we find the "percent malnourished" measure to be most serviceable for fleshing out the nutritional differences among children who differ in other ways.[59]

Table 6: Malnutrition in Relation to Child Health, Kottar Data

		-------- NUTRITION INDICATORS --------		
	Number of Children	Average % of Standard	% Malnourished	% Third Degree
CHILD HEALTH: % OF TIME DIAGNOSED AS SICK	3,546	76.0	45.5	3.9
0 to 20%	570	78.6	33.5	3.2
21 to 40%	1,140	76.1	45.6	3.1
41 to 60%	1,090	75.2	47.5	3.7
61 to 80%	561	74.8	51.3	6.1
81 to 100%	185	75.3	52.4	5.9
Statistical significance		----	.000	.05

Note: Statistical significance is assessed differently for the average percent of standard than for the other two indicators. One-way analysis of variance is used in the former case and chi squares in the latter.

The Kottar sample indicates that malnutrition in Kanyakumari District varies regionally and from village to village. Coastal children are somewhat more likely to be malnourished and to experience third degree malnutrition than are their counterparts in the interior.[60] The differences (see Table 7)

[58]The fact that changes in the average percentage of standard are small when changes in the percentage malnourished are considerable suggests that much of the movement hovers around the 75 percent of standard cut-off point (and, to a lesser extent, the 60 percent of standard cut-off point as well).

[59]The percentage of children in third degree is also a sensitive measure, as well as being a substantively important one. Its limitation in statistical analysis, however, is the restricted range of values usually obtained. In the Kottar data, the percent third degree and the percentage malnourished typically move in the same direction.

[60]This pattern, for July 1977, is at variance with the longitudinal profile shown in Figure 2, reflecting a difference in both type of data (cross-sectional vs. time series) and the indicators of nutritional status employed.

are not great, but they are statistically significant. On balance, the coast is a more hostile environment for small children.[61]

It is the village comparisons that are most eye-catching, however. Even within each region the differences are formidable. On the coast, less than a third of the children in Mel-Manakudy and Enayam are malnourished as compared with half in Colachel and two-thirds or more in Kadiapatanam and En. Puthenthurai. Third degree malnutrition on the coast ranges from 1.8 percent (Mel-Manakudy) to 12.6 percent (En.Puthenthurai) among villages in the sample. Similar disparities are apparent in the interior. In Allanvillai, only a fourth of the children are malnourished, and none are in third degree. By contrast, in Kulasekaram 68 percent are malnourished, with 8 percent in third degree. Not only are village differences more important than regional differences, they are positively striking. In a small district with a uniform climate, villages that to the naked eye seem so similar are profoundly dissimilar in the nutritional status of their children! The relevant data appear in Table 7.[62]

Another striking pattern revealed in the Kottar data is how little nutritional improvement accompanies substantial differences in economic well-being. The same is true of the personal attainments of parents and the

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[61]The reason would appear to be more ecological, or possibly social, than economic. Fisherman families report annual incomes that compare quite favorably with the incomes of other occupational groups.

[62]In addition to showing marked differences among the villages, Table 7 also suggests that the three indicators of nutritional status "move" together, albeit at different paces. As the average percentage of standard declines (marginally), the percentage malnourished increases (dramatically). The incidence of third degree is more independent, but the overall pattern is consistent.

Table 7: Malnutrition by Region and Village, Kottar Data

	Number of Children	NUTRITION INDICATORS: Average % of Standard	% Malnourished	% Third Degree
COAST	858	75.8	48.7	5.1
Mel-Manakudy	109	81.1	28.4	1.8
Enayam	175	80.1	32.0	4.0
Pallam	104	77.2	37.5	1.9
Colachel	103	74.5	50.5	5.8
Midalam	119	74.1	58.8	5.0
Kadiapatanam	129	71.8	67.4	4.7
En. Puthenthurai	119	70.4	69.7	12.6
INTERIOR	2,698	76.0	44.5	3.6
Allanvillai	68	79.2	25.0	0
Melpalai	260	78.5	26.9	1.2
Siluvaipuram	274	78.3	35.0	1.1
Palliady	296	78.0	36.5	2.7
Thirumalai	74	77.5	41.9	5.4
Mulagumudu	197	77.0	39.6	2.0
Manguzhi	224	76.9	38.4	4.0
Kalimar	201	76.5	42.3	3.0
Kandanvilai	213	75.7	43.7	4.7
Parakunnu	[illegible]6	75.3	48.1	2.9
Puthukadai	[illegible]9	73.8	60.4	2.9
Vattam	164	73.5	57.3	7.3
Konamkadu	157	72.6	66.9	5.7
Kulasekaram	225	71.0	68.4	8.0
Statistical significance --				
Region :		----	.05	.05
Village:		----	.000	.000

Note: Villages in each region are ordered according to the average percent of standard revealed by children in the sample.

objective conditions in which people live. Even when our most responsive measure of nutritional status--the percentage of children who are malnourished --is employed, the nutritional gains associated with socioeconomic improvement are remarkably muted.

Education is an example. Forty-eight percent of the children with illiterate fathers in the Kottar sample are malnourished. In households where the father has attained four or five years of schooling, 45 percent of the children are malnourished. In those rather exceptional households where the father has had nine years of schooling or more, 36 percent of the children are malnourished. The comparable figures for third degree are 5 percent, 4 percent and 2 percent. Dramatic differences in education yield statistically significant, substantively meaningful, but--on the whole--rather modest improvements in nutritional status.[63] In fact, in families in which both parents have completed the ninth standard, 30 percent of the children are malnourished, as against 50 percent of the children in families where both parents are illiterate.[64] Again, the difference is considerable but not nearly as considerable as the difference in education. Education and nutrition seem closely linked but the nutritional kick from education is not dominant.

What is true of education is even more true of other statuses. Land ownership makes only a marginal contribution to nutritional well-being, perhaps

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[63]The figures for maternal education are virtually the same. See Appendix IX for these and all distributions based on bivariate analysis.

[64]See Appendix X for the combined effects of fathers' and mothers' education on each nutritional indicator.

because most landholdings are so small.[65] The same applies to the ownership of farm animals, to possession of savings, to household electrification and the availability of private sanitary facilities. In each case the nutritional gains are very modest. Some objective improvements which are by no means easy to come by, appear to have no nutritional payoff whatever: being out of debt, having a tiled roof on one's house and mud rather than thatch walls, and living close to a source of water. Similarly, income, an important variable on which so much else depends, does almost nothing for nutrition; in fact, Kottar families with annual incomes of Rs. 5,000(£40) and above are more likely to have malnourished children than are families with incomes of Rs. 1,000 ($130) or less.[66] Table 8 summarizes several of these patterns.

Two points emerge from Table 8 which are germane to the entire data set. First, if high educational attainment reduces the incidence of early childhood malnutrition by only 12 percent, the fact remains that education has the strongest influence on nutritional status of all the measures of objective status and living conditions which we were able to investigate. Second, it is important to appreciate the substantive significance of the differences examined. Having an electrified home is rare in rural Kanyakumari; fewer than a tenth of the families in our sample had electricity in 1977. Yet this major improvement in living conditions is associated with only a 4 percent

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[65]Almost two-thirds of the sample families living in the interior of the district who owned land, owned less than a tenth of an acre. Only 1 percent of these landowning families claimed to have more than an acre. On the other hand, size of holding is important to nutritional status.

[66]As already noted, we have little confidence in the accuracy of the income data recorded by KSSS. At best these data are approximations of relative affluence.

Table 8: Malnutrition in Relation to Socio-Economic Improvements, Kottar Data

		NUTRITION INDICATORS		
EDUCATION: MALE PARENT		% Standard	% Malnourished	% Third Degree
None	(33%)	75.6	48.0*	5.3*
1st through 3rd std.	(16%)	76.1	45.5	2.9
4th through 5th std.	(32%)	76.0	45.3	3.9
6th through 8th std.	(12%)	75.9	44.8	2.4
9th standard and above	(7%)	78.0	36.3	2.3
ANNUAL FAMILY INCOME				
Rs. 1,000 or less	(5%)	76.1	38.6*	4.7
Rs. 1,500	(20%)	75.6	45.2	4.2
Rs. 2,000	(25%)	76.4	43.6	3.6
Rs. 2,500	(17%)	75.8	46.5	3.1
Rs. 3,000	(11%)	75.2	50.0	4.8
Rs. 5,000	(16%)	76.5	44.0	4.4
Rs. 10,000	(5%)	75.8	53.1	3.6
INDEBTEDNESS				
Yes	(78%)	76.0	45.5	3.7
No	(22%)	75.9	45.5	4.6
HOME: TYPE OF ROOF				
Thatched	(58%)	75.8	45.0	4.5
Tiled	(42%)	76.1	46.5	3.2
HOME: ELECTRICITY				
No	(93%)	75.9	45.8	3.9
Yes	(7%)	77.0	41.4	3.3

*Indicates that the differences are statistically significant at .05 or better.

decline in malnutrition and a .6 percent decline in third degree. Indeed, when we combined several characteristics of people's homes into two scales, one representing the best living conditions (tile roof and stone walls, four or more rooms and windows, electricity, and private latrines), and the other representing the worst conditions (thatched roof and "hut" walls, one room and no windows, no electricity, no latrines, and water source more than a furlong away), neither scale discriminated well on our three measures of nutritional status. More tellingly, the two scales, each reflecting a polarity and then moving toward the center, featured nutritional values which are virtually indistinguishable.[67]

In sum, one message of the Kottar data is that significant improvements in objective socioeconomic conditions are accompanied by modest nutritional gains at best. Perhaps this is because the Kottar sample is not representative: having been drawn from the rural poor, it collapses the total range of change characteristic of the district and thereby camouflages the impact of modernization and objective improvement on nutrition. What disturbs us about this explanation is that malnutrition is principally an affliction of the poor and if one believes that education, higher income and improved living conditions are means of alleviating malnutrition among the poor, then the gains should be evident even in this restricted sample. That the differences in education, income, and living conditions revealed in the Kottar data are not trivial suggests the need for a more theoretical explanation.

We suspect that a "nutrition barrier" is at work. It may be that small children are not benefitted immediately or consequentially by many of

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[67]See Appendix VI.

the grassroots improvements to which development theorists often attach such importance.[68] What we see in the case of Kottar is not the usual failure of trickle-down but the failure of successful local development to have much of an effect on childhood nutrition. Moreover, we are not referring to the failure of development in the absence of a well-targeted nutrition-health intervention. Every child in the sample was enrolled in the CHDP, with the average child having been in it for more than a year and a half receiving supplementary food and health care. Kottar represents grassroots development in combination with an unusually well-managed intervention. Perhaps the latter has neutralized what would otherwise have been the observed effects of the former, an interpretation which may be more hopeful than credible given the results reported in the previous section. Malnutrition is, indeed, a recalcitrant problem.[69]

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[68]This proposition is consistent with the very much lower income elasticities of demand for food on the part of small children vis-a-vis other family members that were recorded by Levinson in Morinda. In terms of food consumed, children did not benefit greatly from rising family income. The Kottar data suggest that the same may hold for other improvements observable at the family level. Source: F. James Levinson, Morinda: An Economic Analysis of Malnutrition Among Children in Rural India, Cornell/MIT International Nutrition Policy Series (1974), pp. 51-53.

[69]The lack of rigor in data generation may be a factor in these results. It is reasonable to infer some masking effects caused by often imprecise recording of child weights and family socioeconomic characteristics by operatives in the CHDP, the errors--in effect--washing out or diluting the actual associations that exist. This possibility is especially likely given the fact that anthropometry is an imprecise means of measuring nutritional status to begin with and the fact that we possess weight data only, thereby confounding acute and chronic malnutrition. Another, more substantive explanation for the extraordinary weakness of the socioeconomic data is that exogenous influences (such as drought and the price of rice) may tend to overwhelm, so far as malnutrition is concerned, the otherwise important differences in status and living conditions observed in the Kottar sample. The analysis in Section III above suggests that this is a live possibility as well. Yet

A third striking pattern revealed in the Kottar data is the importance to nutrition of health parameters. Table 6 has already provided evidence of this: among children diagnosed as sick less than 20 percent of the time by the CHDP staff, only a third were malnourished in July 1977 as compared with half of the children diagnosed as sick on more than 60 percent of their clinic visits. The incidence of third degree malnutrition is similarly much lower among the healthier children. When sickness is disaggregated, fever along with diarrhea and related gastrointestinal disorders emerge as especially important to nutritional status whereas, suprisingly, respiratory diseases are not.[70]

The health diagnoses performed in the CHDP are admittedly crude, often consisting of little more than recording of the mother's comments. Better data would probably give rise to even more impressive results. On the other hand, the association between health and nutrition that we have is about the same as that between education and nutrition. Both are among the strongest to appear in the Kottar data.

Given the relevance of health status to nutrition, it is of interest to note that immunizations tend to be associated with greater rather than lesser malnutrition. One reason for this is that infants (children under a

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another possibility is that much socioeconomic improvement has little bearing on the broader health status of samll children, malnutrition included, an intriguing prospect which receives support from our analysis to follow in the text. In sum, the considerable unresponsiveness of nutritional status to differences in socioeconomic conditions may reflect defects in the data; but it also appears to reflect the substantial as well as substantive power of exogenous influences in Kanyakumari District and the reality of health dynamics in such a setting.

[70]See Appendix IX for the bivariate displays.

year old), who typically have the least malnutrition, are also least likely to have been immunized. However, the pattern holds even for older children, most notably in the case of cholera shots.[71] Kottar policy would seem to give preference to the malnourished in providing immunizations.

There are two exceptions: polio and DPT. Polio vaccine had been provided to almost nine out of every 10 children over one in the sample. Yet those not receiving the vaccine were more likely to be malnourished than those that had (58 percent vs. 48 percent).[72] They were also far more likely to experience third degree malnutrition (10 percent vs. 3 percent).[73] Sixty-one percent of sample children over 12 months of age had been given at least one DPT innoculation, and the nutritional implications of this are reviewed in Table 9. As can be seen, both the incidence and severity of malnutrition increase in the absence of innoculation while dropping markedly (third degree to the vanishing point) the more DPT has been received.

In general, therefore, the importance of health to nutrition is asserted by the Kottar data, confirming what experts already know but, at times, are inclined to pass over lightly in their enthusiasm for multi-sectoral approaches and economic development solutions to malnutrition.

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[71]Only eight percent of sample children over one year of age had been innoculated against cholera, of whom 61 percent were malnourished in July 1977 compared with 48 percent of those not receiving the shot. A similar pattern exists in the case of BCG, which had been given to only a third of the children over one. Immunizations against smallpox, DPT, and polio are much more common.

[72]This is a statistically significant difference at .005.

[73]Significant at .000. In light of these disparities, it is sobering to note that the average percentage of standard differed by less than 3 percent, albeit in the predicted direction.

Table 9: Malnutrition in Relation to Polio and DPT Innoculations Among Children Thirteen Months of Age or Older, Kottar Data

		Number of Children	NUTRITION INDICATORS: Average % Of Standard	% Malnourished	% Third Degree
DPT:	FACT	2,722			
	Yes	1,659	75.8	45.8	2.4
	No	1,063	73.7	54.6	6.0
	Statistical significance		----	.000	.000
DPT:	AMOUNT	2,722			
	None	1,063	73.7	54.6	6.0
	One	319	76.0	47.0	2.5
	Two	1,278	75.7	46.0	2.5
	Three	62	77.4	35.5	0
	Statistical significance		----	.000	.000

Notwithstanding the superficial diagnoses recorded on health sheets in the CHDP and despite what appears to be a Kottar tendency to immunize the already sick in preference to others, health status emerges as an immediate influence on nutritional status that should not be ignored. The close health-nutrition nexus revealed underlines the wisdom of the integrated health-nutrition thrust of the CHDP. It also implies that the "nutrition barrier" to which we have referred is really a health-nutrition barrier. The limited kick given to nutritional improvement by acquisitions (land, animals, catamarans, and nets), greater earnings (including liberation from indebtedness), and generally better living conditions may reflect the failure of such family assets to promote the health of small children. Poor health is a fact of life for most children in the sample, as Table 6 has shown. Malnutrition is simply one manifestation of

a broader condition, and we may infer from the evidence that it will be highly resistant to change unless the entire dynamic of poor health is broken.[74]

Among the social characteristics of Kottar families, two are closely related to malnutrition and to each other. Family size, as measured by the number of children living in the home, is powerfully tied to nutritional status, as Table 10 demonstrates. The more children, the greater and more severe the malnutrition. Even the average percent of standard varies significantly! Similarly, the older the mother, the more malnutrition there tends to be and the worse it becomes.[75]

Table 10: Malnutrition in Relation to Family Size, Kottar Data

		NUTRITION INDICATORS		
	Number of Children	Average % of Standard	% Malnourished	% Third Degree
FAMILY SIZE: NUMBER OF LIVE CHILDREN	3,556			
One	517	77.7	39.3	2.1
Two	690	77.1	40.0	2.0
Three	730	76.4	44.0	3.0
Four	627	75.3	49.3	5.9
Five	442	75.2	48.2	5.2
Six or More	550	73.9	53.8	6.0
Statistical significance		.000	.000	.001

[74]The contribution of education to alleviating malnutrition is probably greater than the contribution of the other statuses, attainments, and conditions which we have examined precisely because education demystifies illness and improves parental capacity to tend to the health needs of children.

[75]Family size and age of the mother are highly correlated, older women typically having more children than younger women. We have examined the three nutritional indicators against each one of these variables while holding the other constant. To our surprise, both survive the controls, although not consistently across categories. Moreover, which categories sustain the relationship and which do not depends on the nutritional indicator examined. We have chosen not to pursue the patterns observed in this text, but the relevant tables have been included as Appendix XII so that others may do so.

What is interesting about these patterns is that they are plausibly tied to child health. A child born into a family that already has several other children is less likely to receive the attention and care given to the offspring of a less harried mother. Moreover, in Kanyakumari District, where rural women work when they can, younger children are often tended to by older siblings; and we may presume that the care provided is less than adequate when the child is experiencing stress. By the same token, older women would seem to be less effective mothers, in the main, than their younger counterparts, although the youngest mothers may be the least competent of all.[76]

Other family characteristics are rather lackluster: whether the family is joint or nuclear (joint is slightly better if much less common);[77] the number of abortions and still births that have occurred (both are quite rare); and even the number of preschool-age deaths reported. We have not fully analyzed two variables of theoretical importance: birth ranking and birth spacing, although the former does appear to make a difference.[78]

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[76]These statements are borne out by the tables referred to in the previous note. The age of marriage is significantly later in Kanyakumari District than it is in most of India, reflecting (among other things) the very much higher levels of female education that exist there. In the Kottar sample only seven mothers (out of 3,524) were between the ages of 15 and 20. Nevertheless, mothers between 20 and 25 (N=328) had children with third degree malnutrition to a much greater extent than did mothers between 26 and 35, again holding the number of children constant.

[77]In joint families, the preferred number of families living in the same house is two. Three or four families significantly raises the prospects of there being malnutrition.

[78]Among Kottar children, birth ranking is usually revealed by the number of live children in the family since, prior to creation of the health cooperatives, the CHDP typically registered the youngest child for receipt of the health and nutrition services provided. As indicated above, family size is a major social factor influencing malnutrition. Birth spacing is crudely recorded in the Kottar data set, children's birth dates being identified by year only.

Three more general sociological characteristics are equally lackluster in their relationship to malnutrition. Religious differences in the population tend not to discriminate when it comes to nutritional status. Hindus and Catholics are virtually identical on our three measures. The small number of Muslim children picked up in the sample reveal the most malnutrition, including the highest incidence of third degree (6 percent). By contrast, non-Catholic Christians have the least malnutrition, particularly third degree (1.9 percent). The overall weakness of religion is underlined when Catholic children are compared regionally. Coastal Catholics are nutritionally worse off than interior Catholics, but neither is distinctive vis-a-vis other children of the same region.

Caste differences are of very little consequence nutritionally. Only the samll number of Nair children in the sample are distinctive, a quarter of them being malnourished as against a sample average of close to half. With no Nairs in third degree, it is apparent that they occupy the advantaged pole and Muslims the disadvantaged pole when ascriptive identities are located on a nutrition continuum. In general, however, there is little to choose between the different castes, ritual ranking and implied social status notwithstanding.

Occupation is almost as ascriptive as religion and caste in rural Kanyakumari, and perhaps for this reason there is again little to choose among the different categories. Farmers are the least likely to have malnourished children and carpenters the most likely. The children of merchants and masons display the least third degree malnutrition and those of weavers and fishmongers the most. What may be a surprise is that the children of fisherman

families and of palmyra climbers and coolie workers closely resemble the sample norm. These particularly humble occupations have generated considerable concern and remedial attention by the Kottar Social Service Society, but malnutrition is not among their special attributes.

Finally, the sex of a child is nutritionally neutral when the NCHS/CDC standards (which have a different growth curve for males and females) are employed. Sex is very much a factor in nutrtion when the VHAI standards (which feature only one curve for both sexes) are used instead. According to the VHAI growth curve, 50 percent of the sample females are malnourished as against only 34 percent of sample males, a highly significant difference which evaporates (and is even reversed slightly) when the sex-sensitive NCHS/CDC standards are the basis for evaluation. This last variable to be considered brings us back to a recurrent theme in the present analysis which finds repeated echo in the other cases analyzed by Community Systems Foundation: the choice of nutrition standards is fraught with meaning when nutritional reality is defined and interpreted. What one sees depends on how it has been measured.

Figure 8 summarizes the bivariate findings reviewed above. In addition, there are numerous specific patterns of interest in the Kottar data, and these may be found in Appendix IX.[79]

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[79]One pattern of interest involves sanitation. A family's having private sanitary facilities may be associated with somewhat lower incidence of malnutrition (42 percent of the sample children in such families as against 46 percent in families lacking latrines totally). On the other hand, sharing a common latrine is worst of all (48 percent, with 7 percent in third degree compared with less than 4 percent for other families). The implication is that, far from breaking the cycle of infection, public facilities accentuate it, perhaps for lack of proper maintenance. This is important in light of the CHDP's "25 paise scheme," under which more than 5,000 slabs for pit latrines had been provided to villages by the end of 1976.

Figure 8: The Context of Malnutrition, Kottar Data

CLEAR, STATISTICALLY SIGNIFICANT, AND STRONG ASSOCIATION WITH % MALNOURISHED AND % THIRD DEGREE

Education: father, mother, and combined
Health status generally; incidence of diarrhea and fever, in particular
DPT and Polio immunizations for children over 12 months of age
Village
Age
Family size

WEAKER OR MIXED ASSOCIATION WITH % MALNOURISHED AND % THIRD DEGREE

Age of the mother
Region: coast vs. interior
Religion
Ownership: farm animals
Number of families in house
House: number of windows
Number of preschool-age deaths in family

NO STATISTICALLY SIGNIFICANT OR MEANIGFUL ASSOCIATION WITH % MALNOURISHED AND % THIRD DEGREE

Sex
Caste
Occupation
Income
Indebtedness
Savings
Food expenditures as a % of income and total expenditures
Total expenditures as a % of income
Incidence of respiratory disease
Smallpox, BCG, and cholera immunizations
Number of abortions and still births
Family type: nuclear vs. joint
Family problems identified
House: type of roof
type of walls
number of rooms
whether electricity
distance to water source: also water quality imputed
Sanitation
Living conditions generally (two additive scales)
Ownership: home
land

Note: Malnutrition is defined as the percentage malnourished (75% of standard) and as the percentage of children in third degree (60% of standard). All attributations are based on the NCHS/CDC standards of normal growth.

We now turn to multivariate analysis in order to look at the ability of combinations of socioeconomic variables to explain (or predict) nutritional status for children in the KSSS program. In particular, we will apply the technique of regression analysis using the child's weight/weight(age) ratio as the dependent variable. Note, this is a major conceptual change from the bivariate analysis done previously. Not only are explanatory variables considered jointly as they relate to nutritional status, but also an interval scale measurement for nutritional status replaces the ordinal scale measure used previously. In order to use regression, the dependent variable must be measured by an interval variable. This introduces information present in the data about the overall variability of the nutritional status measure and eliminates the unsatisfactory dependence on arbitrary "cut-points" for defining degrees of malnutrition.

To apply regression, one should articulate a model (or several models) which encapsulates the hypothesized relationship between a dependent variable and a set of explanatory variables. In this case, the models selected capture several theoretical propositions tempered by the empirical findings already documented in this report.

The relationship between age and nutritional status among preschoolers in the developing world is well-known. We have seen that nutritional status varies with age in a non-linear fashion. The characteristic curves for Kottar take on a parabolic shape; therefore, we hypothesize such a relationship by including not only age in our model but also the square of age.

Many experts in the nutrition field in the developing world argue that birth weight is the single most important determinant of nutritional status in

the preschool years. This is a difficult argument to test with a data set that does not explicitly include the birth weights of all children. However, 76 percent of all children in the Kottar survey were weighed for the first time prior to turning six months old and 90 percent were weighed prior to their first birthday. By including the weight/weight(age) score achieved by these children at the time they were first observed, we can approximate birth weight.

Disease is generally believed to be a factor contributing to malnutrition. In our first model, we utilize the ratio of observations for which a child was sick or hospitalized to the total number of observations for the child.

Birth order is also generally believed to be associated with malnutrition. Although we can not calculate birth order precisely in this data set, we can determine the total number of living children in each family. Furthermore, we know that in most cases, the child sampled is the youngest if not one of the youngest in the family. Therefore, we feel comfortable including the total number of children in the family in the model. Finally, we observed a strong relationship between the sex of the child and malnourishment. This, of course, is a categorical variable which, according to the assumptions underlying the regression technique, must enter our analysis as a dummy variable (one category assumes the value 0, the other the value 1). Thus, our first model, Model I hypothesizes that nutritional status in July of 1977 is a function of:

1) Child age in July 1977;
2) Child age in July 1977 squared;
3) Weight/Weight(age) at first observation;

4) Ratio of reported illnesses to total number of observations;
5) Number of children in the family (NO.SIBS); and,
6) Sex.

A matter of interest is the role of particular diseases in furthering malnutrition. In our earlier empirical work, we saw that diarrhea and fever were related to malnourishment. The ratio of occurrence of each of these diseases to the total number of observations were highly correlated to the overall ratio of disease occurrence to that total. A high correlation between explanatory variables in a regression model results in multi-collinearity--a phenonmenon which can render both highly correlated variables insignificant in the multivariate model when either alone would be significant. Therefore, we substitute the two disease specific ratios for the overall ratio to form Model II. Model II has in addition to variables 1-3 and 5-6:

4a) Ratio of reported diarrhea occurrences to the total number of observations, and

4b) Ratio of reported fever occurrences to the total number of observations.

in place of variable 4 in Model I.

These first two models do not include variables that are generally thought to represent socioeconomic status of a family. Model III and Model IV are expansions of these models that attempt to incorporate socioeconomic indicators. Thus, we include family income, education of the household head, total land available and the amount of the family debt. We considered inclusion of mother's age as well but the high correlation between this variable and number of children in the family again introduces multi-collinearity. Finally, our bivariate analysis showed that village location--coastal or inland--was related to nutritional status. Like sex, we must include this

variable as a dummy variable. In sum, our expanded models III and IV include all the variables in models I and II respectively with the following additional variables:

7) Family income;
8) Education of the household head;
9) Total land available;
10) Amount of family debt;
11) Village type.

In both Models I and II, all the explanatory variables are statistically significant at any level as is the overall relationship. The R^2 value for Model I is .251 while that for Model II is slightly lower at .249. Therefore, we conclude that overall rate of occurrence of disease is a slightly better predictor than the rates of occurrence of diarrhea and fever.[80]

The signs and magnitudes of the coefficients confirm the relationships between variables observed in our earlier analysis. The negative coefficient on the age variable when combined with the positive coefficient on the age-squared variable indicate the parabolic relationship observed when we formed characteristic curves. The better the nutritional status at first weighing (at as young an age as we can compute it), the better the nutritonal status in July of 1977. The disease variable in both models have strong negative coefficients as expected--nutritional status is inversely related to disease rates. Similarly, the greater the number of children in the family, the poorer the nutritional status of the child observed. Finally, the dummy variable for sex indicates that females are approximately three percentage points lower than their male counterparts.

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[80]Appendix XIII presents all of the pertinent values for each of the models described in this section including coefficient values, R-squares significance levels etc.

Of the five socioeconomic variables added in Model III and IV, three are significant--income, total land and village type. Again, the signs of the coefficients conform to our theoretical expectations--income, land and being inland have a positive effect on nutritional status. However, the explanatory power of the model as measured by the R^2 coefficient has hardly increased at all. Less than an additional 1 percent of the variance of the dependent variable is explained by the addition to the five socioeconomic variables to the model.

In formulating these models, we argued that the percentage of standard at first weighing was a useful approximation of birth weight. However, this approximation can be improved if we limit the cases considered in the regression to those children weighed first prior to their third month of life. The four models were run for a second time on this limited number of cases. The results are almost identical.[81] The total explanatory power of the regression has gone up 1 percent even though the number of cases dropped by over half. The most interesting result emerges from the Model III and IV regressions. In both cases the five socioeconomic explanatory variables have coefficients which are not significantly different than zero at the 5 percent level. In other words the socioeconomic variables do not appear to be of much importance in determining child malnourishment.

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[81]See Appendix XIII.

V. CONCLUSION

This study has been an attempt to look at malnutrition as it varies in Kanyakumari District and as it responds to the Community Health Development Project and other activities of the Kottar Social Service Society.

The Kottar data are of interest because they reveal high levels of malnutrition among the rural poor, because the CHDP is an impressive intervention, because the Kottar approach to community development goes well beyond the delivery of services alone, and because the CHDP has produced a rich harvest of socioeconomic information about its intended beneficiaries. Inspired by the Kottar program in its entirety, the analyst is compelled to ask what difference it makes in alleviating the malnutrition of small children. Seized with all the data available, he is encouraged to locate the malnutrition observed in terms of the many factors which might impinge on it. Mindful that the data were not scientifically generated, he is obliged to wonder how serviceable they may be for analytical purposes.

Our analysis of the data has yielded a series of findings that are--at one and the same time--surprising, provocative, and inconclusive. We have seen the vital importance of three decisions which are often made with little forethought as to their influence: the choice of growth standards, the choice of nutrition indicators, and the choice of analytical techniques employed in the analysis. Depending upon the choices made we obtain different results.

We pursued the question of program impact in a setting where one would certainly expect to see evidence of it. We found an improvement in the child population when using the analysis methodology which seemed most appropriate, but we were unable to attribute the cause unambiguously to the CHDP. We observed extraordinary variation in the incidence and severity of malnutrition in villages that look much the same. We discovered that objective social and economic conditions account for very little of this variation, possibly because the power of exogenous influences such as the price of rice overwhelms the usual distinctions among people and how they live, possibly because much objective improvement fails to get at the underlying health dynamic of infection and disease which informs nutritional status, possibly because defects in sampling, the data, and our analysis have masked the actual relationships that exist.

These limitations notwithstanding, the Kottar data represent a goldmine for discovery and insight if not for the definitive testing of formal propositions. They capture a complex reality, and they challenge simple assumptions. In effect, they remind us how little we really know about malnutrition, its determinants, and what strategies are most appropriate for manipulating both. So well understood technically, malnutrition remains elusive programmatically while our knowledge of its socioeconomic parameters has only begun to acquire definition.

Now more than ever, nutrition planners face the considerable task of learning what works, under what conditions, and why. If the Kottar data reveal how difficult it can be to sort out the many things going on in a local environment, they also demonstrate quite clearly that the lessons of

experience are a useful complement to the lessons of the controlled experiment. Finally, this effort dramatizes the significance of local contextual knowledge and the compelling need for that knowledge in shaping a community nutrition intervention.

APPENDIX I

AGE COVERAGE OF THE COMMUNITY HEALTH DEVELOPMENT PROJECT:
PERCENT OF SAMPLE CHILDREN WEIGHED AT DIFFERENT MONTHLY AGES,* KOTTAR DATA

AGE MONTH	%	(N)	AGE MONTH	%	(N)
0	2.5	104	25	43.5	1807
1	12.9	534	26	40.3	1676
2	36.0	1495	27	37.6	1562
3	49.4	2051	28	34.7	1443
4	57.2	2373	29	32.3	1343
5	62.1	2575	30	30.5	1267
6	66.7	2764	31	28.5	1184
7	68.8	2853	32	26.1	1084
8	69.6	2890	33	23.7	984
9	69.6	2887	34	21.6	899
10	69.1	2871	35	19.9	827
11	67.3	2792	36	18.3	762
12	67.8	2815	37	16.7	694
13	66.7	2766	38	15.0	623
14	64.9	2693	39	13.8	573
15	63.4	2629	40	12.2	506
16	61.4	2549	41	10.7	445
17	60.3	2503	42	9.5	396
18	58.6	2433	43	8.9	368
19	57.6	2389	44	7.5	310
20	54.8	2275	45	6.3	261
21	52.9	2194	46	5.4	224
22	50.1	2081	47	4.7	197
23	48.1	1996	48	3.8	159
24	46.0	1908			

* This table omits all children from Kotoorconam village and all "outlier" scores ($<$ 50% weight-for-age $>$ 115%).

APPENDIX II

AGE FLOW BY VILLAGE, KOTTAR DATA

This appendix records, for each village in the sample, the average weight-for-age of children 1 to 48 months old expressed as a percent of standard (Harvard) for each monthly age cohort. These figures are without reference to calendar month or year. If a child was weighed at age 6 months, his weight is included regardless of when that was. Weights above 115% and below 50% of standard are treated as outliers and are omitted from the tabulation.

AGE FLOW BY VILLAGE

AGE MONTH	ENTIRE SAMPLE %	ENTIRE SAMPLE N	ALANVILAI %	ALANVILAI N	COLACHEL %	COLACHEL N	EN-PUTHENTHURAI %	EN-PUTHENTHURAI N
1	90	(537)	88	(18)	79	(17)	96	(21)
2	85	(1499)	82	(30)	80	(51)	89	(56)
3	83	(2056)	84	(47)	80	(63)	85	(71)
4	81	(2381)	81	(49)	78	(72)	84	(81)
5	80	(2583)	81	(54)	78	(69)	83	(86)
6	79	(2771)	78	(61)	78	(76)	81	(94)
7	78	(2859)	78	(64)	77	(70)	79	(93)
8	76	(2894)	77	(70)	76	(78)	77	(99)
9	75	(2892)	75	(72)	76	(78)	76	(92)
10	75	(2875)	75	(76)	75	(83)	75	(97)
11	74	(2797)	76	(73)	73	(85)	75	(91)
12	73	(2819)	75	(77)	75	(76)	72	(90)
13	74	(2771)	75	(72)	73	(71)	73	(87)
14	74	(2698)	76	(72)	74	(72)	73	(85)
15	74	(2635)	76	(72)	73	(66)	73	(77)
16	73	(2553)	76	(69)	73	(65)	72	(77)
17	73	(2507)	76	(62)	71	(60)	72	(79)
18	73	(2437)	75	(60)	72	(59)	73	(73)
19	73	(2393)	76	(61)	71	(48)	72	(75)
20	73	(2279)	77	(59)	70	(51)	72	(68)
21	73	(2198)	76	(54)	70	(47)	72	(70)
22	73	(2084)	76	(54)	69	(46)	71	(61)
23	73	(2000)	76	(53)	70	(41)	71	(58)
24	72	(1910)	76	(53)	69	(37)	71	(60)
25	73	(1808)	77	(52)	68	(33)	72	(58)
26	73	(1676)	77	(49)	68	(30)	71	(52)
27	72	(1562)	77	(45)	68	(23)	72	(52)
28	72	(1443)	76	(40)	67	(20)	72	(47)
29	72	(1343)	77	(32)	65	(20)	72	(46)
30	73	(1267)	77	(28)	67	(20)	73	(42)
31	73	(1184)	77	(25)	67	(17)	73	(40)
32	73	(1084)	77	(21)	69	(9)	75	(34)
33	73	(984)	75	(22)	65	(8)	76	(31)
34	73	(899)	74	(19)	68	(7)	74	(28)
35	73	(827)	74	(18)	69	(5)	75	(30)
36	73	(762)	76	(17)	70	(6)	74	(32)
37	73	(694)	74	(13)	72	(5)	72	(28)
38	73	(623)	77	(12)	74	(4)	72	(27)
39	73	(573)	75	(10)	73	(5)	72	(27)
40	73	(506)	77	(10)	71	(4)	72	(22)
41	73	(445)	78	(10)	69	(4)	73	(23)
42	73	(396)	78	(9)	69	(4)	72	(17)
43	73	(368)	78	(8)	66	(3)	71	(18)
44	73	(310)	76	(7)	69	(3)	72	(15)
45	73	(261)	78	(6)	75	(2)	73	(13)
46	73	(224)	77	(7)	69	(1)	73	(10)
47	72	(197)	76	(6)	72	(1)	72	(10)
48	72	(159)	76	(5)	71	(1)	71	(10)

AGE FLOW BY VILLAGE

AGE MONTH	ENAYAM %	ENAYAM N	KADIAPATANAM %	KADIAPATANAM N	KALIMAR %	KALIMAR N	KANDANVILAI %	KANDANVILAI N
1	90	(52)	88	(20)	86	(34)	85	(18)
2	87	(104)	83	(84)	82	(109)	82	(55)
3	85	(129)	82	(102)	81	(129)	81	(79)
4	82	(142)	80	(103)	80	(136)	79	(102)
5	81	(144)	80	(110)	80	(147)	78	(118)
6	80	(148)	79	(116)	78	(150)	77	(127)
7	79	(150)	77	(116)	78	(153)	76	(140)
8	79	(145)	77	(111)	77	(150)	76	(147)
9	78	(138)	74	(112)	76	(146)	75	(151)
10	77	(138)	74	(108)	76	(146)	74	(149)
11	77	(130)	73	(102)	75	(140)	74	(145)
12	73	(126)	72	(100)	76	(146)	74	(151)
13	74	(123)	73	(95)	75	(141)	75	(146)
14	75	(116)	73	(93)	75	(135)	75	(146)
15	75	(105)	73	(94)	75	(132)	74	(149)
16	74	(100)	72	(88)	74	(131)	75	(144)
17	75	(102)	72	(87)	74	(123)	75	(147)
18	75	(100)	72	(77)	74	(124)	75	(146)
19	75	(101)	72	(78)	74	(123)	74	(141)
20	75	(99)	73	(76)	74	(115)	74	(136)
21	75	(92)	73	(73)	74	(112)	74	(131)
22	75	(91)	73	(69)	74	(101)	74	(132)
23	76	(83)	73	(68)	74	(97)	74	(128)
24	75	(82)	73	(63)	73	(94)	74	(122)
25	75	(81)	73	(60)	73	(87)	73	(119)
26	75	(79)	73	(57)	73	(81)	73	(109)
27	76	(75)	72	(46)	73	(77)	73	(105)
28	76	(71)	72	(40)	72	(68)	73	(97)
29	76	(65)	72	(42)	72	(61)	73	(93)
30	76	(60)	72	(38)	72	(57)	73	(89)
31	77	(55)	72	(33)	72	(53)	73	(81)
32	76	(58)	73	(30)	71	(41)	72	(76)
33	76	(52)	72	(28)	69	(36)	72	(67)
34	76	(45)	73	(28)	68	(27)	72	(66)
35	75	(44)	73	(27)	69	(26)	72	(63)
36	75	(38)	73	(22)	71	(24)	72	(56)
37	75	(34)	73	(22)	71	(23)	72	(55)
38	76	(33)	74	(19)	71	(21)	72	(48)
39	76	(30)	74	(16)	70	(15)	73	(43)
40	75	(28)	73	(14)	68	(11)	73	(39)
41	74	(22)	75	(11)	63	(7)	72	(33)
42	74	(20)	74	(9)	63	(6)	72	(32)
43	78	(15)	71	(7)	63	(7)	72	(29)
44	76	(17)	72	(8)	65	(6)	74	(25)
45	78	(12)	73	(7)	65	(5)	73	(23)
46	75	(11)	73	(6)	61	(4)	73	(23)
47	75	(7)	73	(6)	64	(4)	72	(21)
48	76	(7)	73	(4)	62	(3)	71	(19)

AGE FLOW BY VILLAGE

AGE MONTH	KONAMKADU %	KONAMKADU N	KULASEKARAM %	KULASEKARAM N	MANGUZHI %	MANGUZHI N	MEL-MANAKUDY %	MEL-MANAKUDY N
1	90	(26)	93	(46)	92	(22)	96	(34)
2	84	(65)	84	(102)	85	(94)	89	(70)
3	83	(86)	83	(130)	83	(118)	88	(83)
4	81	(97)	80	(155)	82	(136)	85	(86)
5	81	(108)	80	(162)	81	(146)	85	(92)
6	79	(113)	79	(175)	81	(148)	82	(106)
7	78	(117)	77	(181)	81	(164)	81	(103)
8	76	(125)	77	(184)	80	(170)	79	(101)
9	76	(120)	75	(190)	78	(180)	77	(94)
10	75	(121)	75	(186)	78	(178)	77	(89)
11	75	(118)	74	(175)	77	(178)	75	(79)
12	74	(121)	72	(183)	76	(181)	76	(81)
13	74	(124)	72	(180)	76	(184)	78	(79)
14	75	(125)	72	(177)	76	(178)	77	(74)
15	75	(121)	72	(170)	75	(163)	77	(72)
16	74	(116)	71	(159)	75	(161)	77	(70)
17	74	(113)	71	(158)	75	(152)	78	(67)
18	74	(110)	71	(159)	74	(148)	77	(62)
19	73	(114)	71	(148)	75	(140)	76	(62)
20	73	(105)	71	(140)	74	(138)	76	(61)
21	73	(104)	70	(140)	74	(129)	77	(55)
22	73	(99)	71	(123)	74	(126)	76	(54)
23	72	(101)	71	(123)	74	(119)	76	(51)
24	71	(99)	71	(117)	74	(111)	76	(50)
25	71	(92)	70	(106)	74	(100)	76	(47)
26	71	(86)	70	(102)	75	(96)	76	(46)
27	71	(79)	69	(97)	75	(87)	76	(42)
28	73	(69)	69	(86)	74	(87)	77	(40)
29	72	(62)	69	(80)	73	(83)	76	(36)
30	73	(64)	70	(69)	74	(79)	78	(35)
31	73	(61)	69	(67)	74	(77)	78	(30)
32	73	(56)	71	(55)	74	(63)	80	(25)
33	72	(48)	71	(49)	75	(58)	79	(27)
34	72	(48)	69	(39)	74	(57)	79	(24)
35	72	(48)	70	(41)	73	(47)	80	(23)
36	71	(44)	70	(36)	74	(48)	80	(22)
37	72	(41)	68	(26)	73	(44)	79	(18)
38	72	(38)	70	(22)	74	(41)	79	(14)
39	72	(36)	68	(20)	74	(41)	80	(14)
40	72	(32)	70	(15)	74	(34)	79	(13)
41	74	(27)	70	(12)	74	(27)	81	(12)
42	73	(29)	69	(11)	73	(22)	81	(9)
43	72	(27)	68	(13)	73	(19)	83	(11)
44	72	(24)	73	(7)	73	(16)	83	(9)
45	73	(21)	72	(5)	73	(11)	85	(5)
46	71	(17)	70	(3)	78	(8)	83	(6)
47	72	(17)	65	(2)	72	(7)	83	(6)
48	70	(15)	65	(1)	77	(2)	84	(5)

AGE FLOW BY VILLAGE

AGE MONTH	MELPALAI %	MELPALAI N	NIDALAM %	NIDALAM N	MULAGUMUDU %	MULAGUMUDU N	PALLAM %	PALLAM N
1	91	(17)	89	(11)	91	(19)	94	(41)
2	88	(85)	85	(37)	85	(70)	89	(74)
3	85	(145)	85	(67)	81	(97)	89	(88)
4	82	(182)	81	(77)	79	(118)	86	(95)
5	81	(216)	84	(84)	78	(135)	87	(94)
6	80	(230)	81	(89)	76	(142)	84	(96)
7	79	(232)	78	(100)	75	(152)	82	(99)
8	77	(239)	77	(93)	74	(154)	80	(96)
9	76	(241)	75	(92)	73	(159)	79	(92)
10	76	(234)	75	(91)	72	(154)	77	(93)
11	75	(233)	75	(81)	72	(154)	76	(91)
12	75	(233)	73	(82)	73	(154)	75	(89)
13	76	(233)	73	(86)	73	(155)	75	(87)
14	76	(226)	72	(84)	74	(149)	76	(84)
15	75	(227)	73	(80)	73	(146)	76	(82)
16	75	(228)	72	(76)	72	(139)	74	(84)
17	75	(226)	72	(71)	72	(135)	75	(81)
18	75	(214)	71	(69)	72	(131)	74	(77)
19	75	(213)	70	(73)	72	(129)	74	(75)
20	74	(199)	70	(66)	71	(120)	74	(68)
21	74	(197)	71	(66)	72	(112)	74	(68)
22	74	(190)	72	(62)	72	(106)	74	(64)
23	74	(182)	71	(62)	72	(102)	74	(64)
24	74	(171)	71	(62)	70	(89)	74	(57)
25	74	(166)	71	(55)	72	(87)	75	(54)
26	74	(155)	70	(49)	72	(77)	75	(49)
27	74	(147)	69	(44)	72	(76)	75	(46)
28	73	(139)	69	(40)	72	(72)	75	(41)
29	73	(134)	69	(41)	71	(62)	75	(39)
30	74	(126)	69	(35)	71	(59)	75	(37)
31	74	(117)	69	(31)	72	(57)	75	(33)
32	74	(111)	69	(31)	72	(53)	76	(31)
33	74	(99)	69	(29)	73	(47)	76	(30)
34	74	(94)	71	(26)	71	(41)	75	(28)
35	74	(81)	72	(21)	71	(38)	74	(27)
36	74	(79)	71	(19)	73	(31)	76	(28)
37	74	(71)	71	(17)	70	(27)	76	(25)
38	73	(64)	70	(13)	72	(25)	76	(21)
39	74	(56)	69	(13)	71	(23)	75	(23)
40	73	(48)	69	(13)	72	(23)	74	(20)
41	73	(43)	70	(11)	73	(22)	75	(17)
42	73	(40)	71	(7)	72	(21)	75	(14)
43	73	(38)	73	(6)	72	(19)	76	(13)
44	73	(35)	68	(6)	75	(13)	75	(14)
45	72	(30)	69	(6)	71	(10)	75	(13)
46	73	(26)	67	(4)	72	(9)	74	(12)
47	72	(20)	68	(3)	73	(9)	74	(11)
48	70	(14)	65	(4)	75	(6)	76	(10)

AGE FLOW BY VILLAGE

AGE MONTH	PALLIADY %	PALLIADY N	PARAKUNNU %	PARAKUNNU N	PUTHUKADAI %	PUTHUKADAI N	SILUVAIPURAM %	SILUVAIPURAM N
1	87	(33)	87	(17)	90	(13)	87	(35)
2	83	(98)	91	(90)	84	(41)	82	(93)
3	82	(153)	88	(128)	82	(71)	81	(139)
4	80	(193)	83	(152)	79	(87)	79	(167)
5	80	(213)	81	(157)	78	(95)	80	(187)
6	77	(227)	79	(178)	76	(105)	79	(215)
7	76	(228)	76	(182)	74	(114)	78	(225)
8	74	(229)	75	(183)	73	(113)	77	(236)
9	73	(227)	73	(178)	72	(117)	75	(241)
10	72	(231)	72	(171)	71	(120)	75	(235)
11	71	(231)	72	(170)	71	(114)	74	(227)
12	70	(229)	72	(175)	71	(116)	73	(230)
13	71	(224)	72	(179)	72	(112)	74	(222)
14	72	(219)	72	(174)	72	(114)	73	(210)
15	72	(220)	72	(177)	72	(111)	73	(211)
16	71	(215)	71	(167)	72	(111)	72	(196)
17	71	(213)	71	(164)	72	(107)	73	(203)
18	71	(205)	70	(162)	72	(104)	73	(203)
19	71	(203)	70	(161)	72	(99)	73	(202)
20	71	(197)	70	(153)	72	(95)	73	(190)
21	71	(189)	70	(152)	72	(83)	73	(186)
22	72	(168)	70	(142)	72	(84)	73	(176)
23	72	(162)	70	(134)	73	(79)	73	(170)
24	71	(160)	70	(133)	72	(76)	72	(160)
25	72	(151)	70	(125)	73	(73)	72	(153)
26	71	(132)	71	(121)	73	(69)	72	(137)
27	71	(120)	70	(113)	72	(65)	72	(127)
28	71	(113)	70	(107)	72	(63)	71	(116)
29	72	(106)	70	(96)	72	(57)	72	(106)
30	71	(96)	71	(95)	72	(57)	72	(108)
31	72	(92)	70	(94)	73	(49)	72	(99)
32	72	(87)	71	(84)	73	(47)	72	(96)
33	73	(78)	71	(76)	74	(44)	72	(88)
34	74	(65)	71	(75)	73	(40)	73	(75)
35	73	(59)	71	(66)	73	(34)	73	(69)
36	72	(50)	71	(60)	73	(34)	73	(62)
37	73	(50)	71	(56)	73	(33)	74	(57)
38	73	(43)	71	(51)	74	(30)	74	(50)
39	73	(36)	72	(49)	74	(29)	74	(43)
40	73	(31)	71	(45)	73	(23)	73	(41)
41	71	(26)	72	(42)	73	(25)	73	(34)
42	70	(24)	72	(37)	72	(22)	73	(30)
43	72	(23)	72	(38)	73	(18)	74	(26)
44	69	(20)	72	(28)	72	(15)	71	(16)
45	69	(14)	71	(31)	72	(12)	71	(9)
46	68	(9)	71	(28)	75	(8)	72	(8)
47	67	(10)	70	(24)	76	(7)	72	(7)
48	65	(9)	71	(19)	71	(5)	73	(6)

AGE FLOW BY VILLAGE

AGE MONTH	THIRUMALAI %	THIRUMALAI N	VATTAM %	VATTAM N
1	89	(12)	89	(28)
2	77	(21)	84	(66)
3	75	(34)	80	(92)
4	75	(40)	78	(103)
5	75	(44)	77	(114)
6	77	(49)	76	(119)
7	76	(53)	76	(117)
8	76	(51)	74	(116)
9	75	(48)	73	(119)
10	75	(50)	73	(121)
11	76	(54)	72	(121)
12	73	(50)	73	(125)
13	74	(48)	73	(118)
14	74	(48)	73	(112)
15	74	(43)	72	(111)
16	73	(43)	72	(110)
17	73	(43)	73	(110)
18	75	(39)	72	(111)
19	73	(34)	72	(109)
20	72	(31)	72	(108)
21	71	(30)	72	(104)
22	71	(32)	72	(101)
23	72	(28)	73	(91)
24	71	(23)	73	(89)
25	72	(25)	73	(83)
26	71	(25)	73	(75)
27	72	(21)	73	(75)
28	73	(21)	73	(66)
29	73	(20)	72	(62)
30	73	(15)	71	(58)
31	73	(15)	71	(58)
32	73	(18)	72	(58)
33	74	(16)	72	(51)
34	73	(15)	71	(52)
35	74	(12)	71	(48)
36	75	(8)	73	(46)
37	76	(8)	73	(41)
38	73	(8)	74	(39)
39	71	(6)	73	(38)
40	69	(4)	73	(36)
41	72	(3)	73	(34)
42	71	(3)	73	(30)
43	61	(1)	72	(29)
44	67	(2)	73	(24)
45	66	(2)	73	(24)
46	70	(1)	72	(23)
47	66	(1)	72	(18)
48	--	(0)	71	(14)

APPENDIX III

MONTHLY AGE FLOW BY THE GOMEZ CLASSIFICATION, KOTTAR DATA

Average Weight-for-Age as a Percent of Standard (Harvard)

Monthly Age	NORMAL 90.0+	FIRST DEGREE 75.0-89.9	SECOND DEGREE 60.0-74.9	THIRD DEGREE <60.0	(N)
1	94	3	3	0	(104)
2	65	18	15	3	(627)
3	34	46	19	1	(1,599)
4	27	46	24	3	(2,146)
5	21	49	26	4	(2,442)
6	21	42	32	5	(2,653)
7	14	45	36	6	(2,841)
8	13	43	38	7	(2,904)
9	7	48	37	8	(2,953)
10	6	42	44	9	(2,954)
11	5	44	43	8	(2,917)
12	4	40	48	8	(2,836)
13	3	38	51	8	(2,855)
14	3	39	51	7	(2,802)
15	3	40	52	7	(2,743)
16	3	40	50	7	(2,669)
17	3	37	52	8	(2,591)
18	2	36	53	7	(2,543)
19	2	35	55	9	(2,474)
20	2	34	56	7	(2,423)
21	2	36	55	8	(2,303)
22	2	38	53	7	(2,218)
23	2	36	55	7	(2,108)
24	1	37	55	7	(2,017)
25	1	35	57	8	(1,926)
26	2	36	56	7	(1,819)
27	2	35	57	6	(1,683)
28	2	37	55	6	(1,571)
29	2	34	58	7	(1,450)
30	2	31	60	7	(1,354)
31	2	34	58	6	(1,273)
32	2	[illegible]	57	7	(1,192)
33	2	38	54	6	(1,089)
34	2	37	55	6	(988)
35	2	36	55	7	(900)
36	2	35	55	8	(827)

Average Weight-for-Age as a Percent of Standard (Harvard)

Monthly Age	NORMAL 90.0+	FIRST DEGREE 75.0-89.9	SECOND DEGREE 60.0-74.9	THIRD DEGREE <60.0	(N)
37	2	34	60	4	(766)
38	1	33	60	5	(700)
39	1	38	57	5	(627)
40	2	35	59	4	(577)
41	1	34	61	4	(509)
42	1	34	59	6	(453)
43	1	35	59	6	(396)
44	1	35	59	5	(371)
45	2	36	58	5	(312)
46	1	33	60	5	(264)
47	2	35	56	8	(226)
48	2	33	58	8	(200)
49	2	29	61	8	(160)
50	2	28	64	7	(132)
51	2	27	62	10	(104)
52	1	28	64	6	(78)
53	0	21	72	7	(61)
54	0	29	63	8	(51)
55	0	22	70	8	(37)
56	0	23	73	3	(30)
57	0	33	52	14	(21)
58	0	24	59	18	(17)
59	0	23	54	23	(13)
60	0	11	67	22	(9)

Note: The percentage figures add to 100% horizontally (discrepancies due to rounding). Figures in parentheses refer to the number of children weighed at each monthly age shown.

APPENDIX IV

MONTHLY AGE FLOW BY THE INDIAN ACADEMY OF PEDIATRICS (IAP) CLASSIFICATION, KOTTAR DATA

Average Weight-for-Age as a Percent of Standard (Harvard)

Monthly Age	NORMAL 80.0+	FIRST DEGREE 70.0-79.9	SECOND DEGREE 60.0-69.9	THIRD DEGREE 50.0-59.9	FOURTH DEGREE <50.0	(N)
1	97	1	2	0	0	(104)
2	79	12	7	1	1	(627)
3	65	21	11	2	1	(1,599)
4	55	33	9	3	0	(2,146)
5	47	33	16	4	1	(2,442)
6	52	30	11	5	1	(2,653)
7	45	30	19	5	2	(2,841)
8	41	32	20	6	1	(2,904)
9	34	37	19	8	2	(2,953)
10	26	40	25	8	2	(2,954)
11	26	41	24	7	2	(2,917)
12	25	39	26	8	1	(2,836)
13	22	42	26	9	1	(2,855)
14	21	46	25	6	2	(2,802)
15	19	48	26	6	2	(2,743)
16	20	43	[illegible]	7	1	(2,669)
17	17	45	[illegible]	8	2	(2,591)
18	18	46	27	7	2	(2,543)
19	18	44	29	8	2	(2,474)
20	20	44	27	8	1	(2,423)
21	19	41	31	8	1	(2,303)
22	18	42	32	7	1	(2,218)
23	19	39	34	6	2	(2,108)
24	19	40	32	8	1	(2,017)
25	17	42	32	8	1	(1,926)
26	17	44	30	8	1	(1,819)
27	19	44	29	8	1	(1,683)
28	17	44	31	8	1	(1,571)
29	15	44	34	7	1	(1,450)
30	17	42	33	8	1	(1,354)
31	17	43	32	8	1	(1,273)
32	16	43	33	8	1	(1,192)
33	19	44	30	7	0	(1,089)
34	18	47	27	7	1	(988)
35	15	47	29	8	1	(900)
36	18	43	30	9	1	(827)

Average Weight-for-Age as a Percent of Standard (Harvard)

Monthly Age	NORMAL 80.0+	FIRST DEGREE 70.0-79.9	SECOND DEGREE 60.0-69.9	THIRD DEGREE 50.0-59.9	FOURTH DEGREE <50.0	(N)
37	17	43	34	6	1	(766
38	17	46	31	5	1	(700
39	19	43	33	5	1	(627
40	20	41	33	5	1	(577
41	17	44	32	6	2	(509
42	18	43	31	6	1	(453
43	17	46	31	6	1	(396
44	16	44	34	5	1	(371
45	15	46	33	5	1	(312
46	14	44	35	6	1	(264
47	14	44	33	8	1	(226
48	14	46	33	8	1	(200
49	12	48	32	9	0	(160
50	14	46	27	11	1	(132
51	9	50	32	9	1	(104
52	10	49	33	8	0	(78
53	8	51	31	8	2	(61
54	16	37	37	10	0	(51
55	8	35	49	5	3	(37
56	10	33	53	3	0	(30
57	19	29	38	14	0	(21
58	12	29	41	12	6	(17
59	31	46	15	8	0	(13
60	11	0	56	33	0	(9

Note: The percentage figures add to 100% horizontally (discrepancies due to rounding). Figures in parentheses refer to the number of children weighed at each monthly age shown.

APPENDIX V

TIME FLOW BY REGION, KOTTAR DATA

Average Weight-for-Age as a Percent of Standard (Harvard)

		COAST		INTERIOR		SAMPLE	
		%	(N)	%	(N)	%	(N)
1974:	January	80	(43)	79	(89)	79	(132)
	February	78	(49)	77	(105)	77	(154)
	March	79	(56)	77	(133)	78	(189)
	April	77	(59)	77	(162)	77	(221)
	May	79	(74)	76	(179)	77	(253)
	June	79	(86)	75	(202)	76	(288)
	July	79	(93)	74	(248)	75	(341)
	August	77	(101)	73	(267)	74	(368)
	September	80	(121)	75	(325)	76	(446)
	October	80	(147)	75	(410)	76	(557)
	November	79	(153)	75	(452)	76	(605)
	December	78	(164)	75	(513)	75	(677)
1975:	January	78	(187)	75	(606)	76	(793)
	February	79	(204)	75	(653)	76	(857)
	March	78	(213)	75	(735)	75	(948)
	April	78	(226)	75	(791)	76	(1,017)
	May	77	(236)	74	(824)	75	(1,060)
	June	77	(241)	74	(903)	75	(1,144)
	July	77	(268)	74	(989)	75	(1,257)
	August	75	(296)	73	(1,038)	74	(1,334)
	September	77	(298)	74	(1,141)	74	(1,439)
	October	76	(339)	73	(1,234)	74	(1,573)
	November	75	(354)	73	(1,238)	74	(1,592)
	December	75	(386)	73	(1,411)	74	(1,797)
1976:	January	75	(427)	74	(1,517)	74	(1,944)
	February	76	(437)	73	(1,618)	74	(2,055)
	March	76	(478)	73	(1,655)	74	(2,133)
	April	76	(458)	73	(1,685)	73	(2,143)
	May	75	(477)	73	(1,719)	73	(2,196)
	June	76	(564)	74	(2,001)	74	(2,565)
	July	76	(582)	74	(2,052)	74	(2,634)
	August	75	(580)	74	(2,134)	74	(2,714)
	September	75	(630)	74	(2,234)	74	(2,864)
	October	75	(673)	74	(2,284)	74	(2,957)
	November	76	(704)	74	(2,317)	74	(3,021)
	December	76	(737)	74	(2,333)	75	(3,070)
1977:	January	76	(799)	74	(2,506)	75	(3,305)
	February	76	(831)	75	(2,604)	75	(3,435)
	March	77	(859)	75	(2,6[illegible]4)	75	(3,523)
	April	77	(860)	75	(2,690)	76	(3,550)
	May	76	(881)	75	(2,704)	76	(3,585)
	June	76	(886)	75	(2,751)	76	(3,637)
	July	75	(845)	75	(2,667)	75	(3,512)
	August	75	(699)	75	(2,390)	75	(3,089)

Note: Weights above 115% and below 50% of standard have been treated as outliers and are omitted from this tabulation.

APPENDIX VI

TIME FLOW BY VILLAGE, KOTTAR DATA

This appendix documents the growth performance of the average child in each sample village between 1974 and 1977. The figures for each month are the average weight-for-age as a percent of standard (Harvard) for all children weighed at the time, regardless of age, with the figures in parentheses being the number of children to which this average figure pertains. No figure is shown when fewer than ten sample children in each village were weighed. Children weighing more than 115% or less than 50% of standard have been excluded as outliers.

TIME FLOW

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Alanvilai												
1974:								67 (10)	71 (10)	72 (10)	-	67 (12)
1975:	68 (12)	-	76 (24)	77 (32)	76 (32)	78 (35)	78 (34)	79 (36)	79 (42)	78 (42)	78 (37)	74 (49)
1976:	75 (52)	74 (54)	74 (56)	74 (55)	74 (52)	74 (62)	73 (69)	73 (74)	74 (76)	75 (78)	77 (81)	79 (86)
1977:	80 (83)	82 (80)	80 (88)	81 (90)	81 (88)	80 (82)	78 (70)	78 (57)				
Kalimar												
1974:						79 (11)	78 (13)	75 (17)	79 (18)	82 (21)	84 (20)	82 (25)
1975:	80 (34)	80 (38)	78 (42)	78 (41)	78 (38)	76 (52)	76 (53)	75 (56)	77 (53)	78 (62)	78 (60)	76 (84)
1976:	75 (87)	75 (94)	74 (95)	74 (92)	74 (103)	75 (129)	73 (132)	73 (133)	74 (146)	74 (148)	76 (152)	76 (174)
1977:	75 (174)	75 (180)	75 (192)	74 (196)	74 (195)	75 (202)	76 (199)	75 (176)				
Kandanvilai												
1974:												74 (35)
1975:	71 (46)	69 (52)	69 (61)	68 (57)	69 (62)	72 (77)	72 (79)	71 (82)	71 (83)	72 (89)	72 (85)	71 (105)
1976:	72 (119)	71 (129)	72 (127)	72 (134)	72 (129)	74 (161)	75 (165)	75 (170)	76 (190)	78 (195)	78 (196)	77 (195)
1977:	78 (208)	77 (219)	76 (228)	76 (226)	76 (236)	76 (234)	75 (212)	74 (163)				
Colachel												
1974:											75 (10)	73 (11)
1975:	75 (13)	70 (14)	73 (17)	72 (17)	71 (18)	73 (15)	69 (19)	68 (25)	71 (21)	71 (25)	71 (23)	74 (32)
1976:	74 (34)	74 (41)	74 (41)	74 (35)	74 (37)	75 (64)	73 (60)	72 (58)	73 (62)	74 (74)	74 (80)	75 (86)
1977:	75 (88)	74 (93)	74 (99)	74 (99)	73 (98)	73 (103)	74 (100)	72 (53)				

TIME FLOW

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
En-Puthen-thurai												
1974:						81 (15)	82 (17)	79 (19)	81 (22)	79 (24)	75 (24)	75 (24)
1975:	79 (26)	85 (33)	82 (35)	80 (34)	80 (34)	78 (37)	77 (38)	79 (42)	83 (46)	81 (51)	79 (49)	78 (58)
1976:	77 (64)	77 (67)	76 (78)	76 (69)	75 (70)	76 (85)	75 (87)	76 (81)	75 (90	74 (93)	73 (98)	73 (107)
1977:	72 (112)	73 (117)	72 (113)	72 (115)	71 (119)	71 (121)	70 (115)	70 (102)				
Kadia-patanam												
1974:					74 (10)	76 (11)	77 (13)	72 (12)	75 (15)	77 (19)	77 (16)	74 (13)
1975:	77 (25)	79 (27)	79 (26)	77 (31)	77 (34)	76 (34)	77 (41)	75 (48)	75 (44)	74 (51)	75 (54)	78 (65)
1976:	76 (64)	76 (64)	75 (70)	75 (71)	73 (71)	75 (88)	75 (96)	76 (97)	75 (104)	77 (113)	76 (117)	76 (119)
1977:	75 (123)	74 (128)	74 (134)	74 (134)	74 (133	73 (131)	71 (127)	71 (112)				
Enayam												
1974:	75 (11)	74 (12)	74 (14)	75 (15)	77 (19)	77 (23)	77 (24)	77 (28)	79 (32)	75 (33)	77 (37)	77 (40)
1975:	76 (49)	76 (50)	76 (52)	76 (52)	75 (51)	74 (54)	75 (64)	75 (68)	76 (69)	76 (67)	75 (78)	74 (78)
1976:	76 (84)	76 (84)	75 (96)	75 (92)	74 (97)	74 (110)	76 (111)	75 (114)	76 (124)	77 (130)	76 (133)	76 (141)
1977:	77 (162)	79 (172)	81 (178)	82 (177)	82 (186)	81 (184)	80 (176)	79 (159)				
Midalam												
1974:									88 (10)	84 (13)	82 (17)	81 (18)
1975:	82 (22)	78 (21)	77 (20)	78 (25)	79 (25)	80 (26)	79 (28)	70 (29)	75 (33)	75 (46)	71 (48)	69 (45)
1976:	71 (63)	73 (64)	75 (64)	74 (62)	73 (61)	73 (70)	72 (76)	73 (75)	72 (85)	71 (96)	72 (102)	72 (106)
1977:	73 (111)	74 (107)	74 (115)	75 (113)	74 (116)	73 (116)	73 (117)	72 (110)				

TIME FLOW

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Konemkadu												
1974:	85 (12)	79 (12)	81 (14)	81 (14)	78 (14)	78 (15)	78 (16)	76 (17)	75 (29)	76 (35)	75 (37)	76 (38)
1975:	79 (41)	77 (45)	75 (49)	78 (53)	77 (55)	76 (56)	77 (62)	77 (63)	76 (68)	75 (85)	73 (90)	69 (94)
1976:	72 (96)	73 (100)	74 (99)	74 (105)	75 (103)	78 (118)	78 (127)	77 (133)	77 (138)	77 (139)	76 (140)	75 (135)
1977:	73 (144)	72 (151)	72 (152)	73 (153)	73 (159)	72 (159)	72 (158)	73 (147)				
Kulasekaram												
1974:									73 (10)	73 (24)	72 (25)	71 (24)
1975:	76 (39)	76 (39)	75 (45)	78 (58)	77 (62)	77 (72)	75 (69)	74 (73)	76 (98)	75 (101)	77 (101)	76 (105)
1976:	79 (113)	78 (120)	78 (124)	76 (127)	75 (130)	76 (169)	75 (171)	75 (176)	74 (183)	72 (191)	72 (203)	73 (206)
1977:	72 (214)	71 (214)	71 (222)	71 (213)	72 (218)	70 (221)	70 (214)	70 (208)				
Manguzhi												
1974:									80 (26)	78 (34)	77 (44)	77 (47)
1975:	77 (49)	76 (52)	76 (53)	81 (71)	80 (72)	78 (70)	78 (83)	77 (85)	75 (95)	74 (105)	74 (105)	75 (120)
1976:	75 (120)	74 (127)	73 (132)	73 (129)	75 (136)	78 (155)	78 (155)	78 (162)	78 (171)	78 (171)	77 (171)	77 (166)
1977:	76 (195)	76 (217)	77 (211)	77 (209)	77 (210)	78 (218)	77 (224)	75 (215)				
Mulagumudu												
1974:							74 (21)	70 (22)	67 (22)	73 (30)	75 (32)	75 (32)
1975:	78 (38)	77 (41)	77 (50)	75 (53)	76 (58)	75 (57)	75 (59)	74 (60)	74 (66)	74 (73)	74 (73)	75 (77)
1976:	74 (95)	74 (108)	73 (106)	72 (104)	71 (103)	71 (127)	71 (131)	70 (140)	71 (149)	71 (158)	72 (162)	73 (164)
1977:	73 (177)	73 (177)	73 (184)	74 (183)	75 (183)	76 (194)	77 (195)	76 (181)				

TIME FLOW

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Pallam												
1973:												78 (10)
1974:	82 (11)	81 (14)	82 (15)	79 (16)	81 (20)	80 (18)	77 (16)	78 (18)	82 (22)	83 (30)	81 (29)	81 (31)
1975:	81 (30)	81 (33)	79 (33)	78 (30)	78 (34)	79 (36)	78 (36)	78 (40)	78 (44)	77 (52)	76 (54)	76 (56)
1976:	75 (60)	76 (62)	77 (68)	79 (69)	79 (76)	79 (80)	79 (84)	77 (85)	77 (89)	78 (92)	79 (92)	78 (96)
1977:	76 (103)	77 (105)	78 (107)	77 (109)	76 (111)	77 (114)	77 (103)	78 (88)				
Palliady												
1973:										79 (10)	69 (10)	75 (10)
1974:	76 (16)	73 (16)	76 (19)	75 (24)	75 (27)	73 (28)	74 (29)	75 (33)	77 (37)	76 (56)	76 (63)	74 (62)
1975:	76 (60)	76 (67)	76 (74)	76 (72)	76 (80)	75 (83)	75 (92)	74 (96)	74 (116)	71 (124)	69 (124)	69 (124)
1976:	70 (159)	69 (167)	69 (176)	68 (182)	68 (184)	69 (211)	69 (212)	69 (230)	70 (231)	71 (238)	70 (232)	71 (227)
1977:	71 (237)	74 (261)	77 (262)	77 (277)	77 (276)	77 (285)	77 (285)	78 (249)				
Parakunnu												
1974:	78 (13)	78 (16)	75 (25)	78 (32)	76 (34)	77 (42)	75 (47)	74 (48)	76 (49)	75 (63)	74 (72)	74 (64)
1975:	73 (73)	73 (80)	74 (89)	73 (90)	72 (90)	72 (98)	73 (104)	74 (111)	75 (115)	75 (121)	75 (123)	75 (129)
1976:	74 (139)	73 (142)	71 (142)	70 (139)	70 (137)	72 (167)	71 (162)	71 (180)	71 (174)	70 (181)	70 (178)	70 (174)
1977:	73 (200)	73 (208)	74 (209)	74 (214)	74 (211)	74 (220)	74 (202)	74 (171)				

TIME FLOW

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Puthukadai												
1974:				80 (13)	77 (15)	77 (15)	76 (17)	72 (17)	76 (25)	72 (26)	71 (26)	70 (27)
1975:	69 (32)	68 (34)	67 (35)	70 (46)	69 (47)	71 (51)	70 (52)	71 (53)	72 (64)	73 (67)	73 (71)	73 (73)
1976:	73 (78)	73 (75)	71 (84)	72 (92)	72 (102)	72 (110)	74 (112)	75 (111)	75 (119)	75 (119)	75 (122)	74 (108)
1977:	75 (131)	75 (131)	75 (136)	74 (140)	74 (146)	73 (146)	74 (138)	73 (119)				
Siluvaipuram												
1974:			74 (10)	75 (11)	76 (15)	76 (16)	73 (20)	75 (23)	72 (26)	68 (31)	72 (35)	78 (47)
1975:	74 (53)	74 (54)	77 (59)	75 (61)	74 (58)	76 (76)	74 (105)	74 (112)	73 (118)	72 (122)	73 (122)	75 (166)
1976:	74 (146)	73 (184)	73 (192)	73 (191)	73 (192)	73 (219)	73 (232)	72 (237)	72 (247)	71 (252)	72 (253)	73 (265)
1977:	75 (275)	76 (279)	77 (278)	77 (279)	78 (269)	78 (276)	78 (274)	77 (244)				
Melpalai												
1973:											80 (12)	78 (14)
1974:	79 (16)	75 (20)	75 (25)	74 (28)	72 (29)	71 (29)	73 (36)	73 (37)	76 (43)	76 (46)	76 (49)	75 (63)
1975:	76 (87)	77 (97)	77 (103)	75 (109)	74 (115)	74 (120)	73 (132)	72 (140)	72 (144)	72 (149)	73 (150)	75 (179)
1976:	76 (192)	77 (194)	77 (202)	76 (203)	76 (211)	76 (220)	76 (226)	76 (227)	76 (236)	76 (236)	76 (242)	76 (246)
1977:	76 (264)	76 (270)	76 (273)	77 (278)	77 (278)	77 (278)	78 (262)	78 (234)				

TIME FLOW

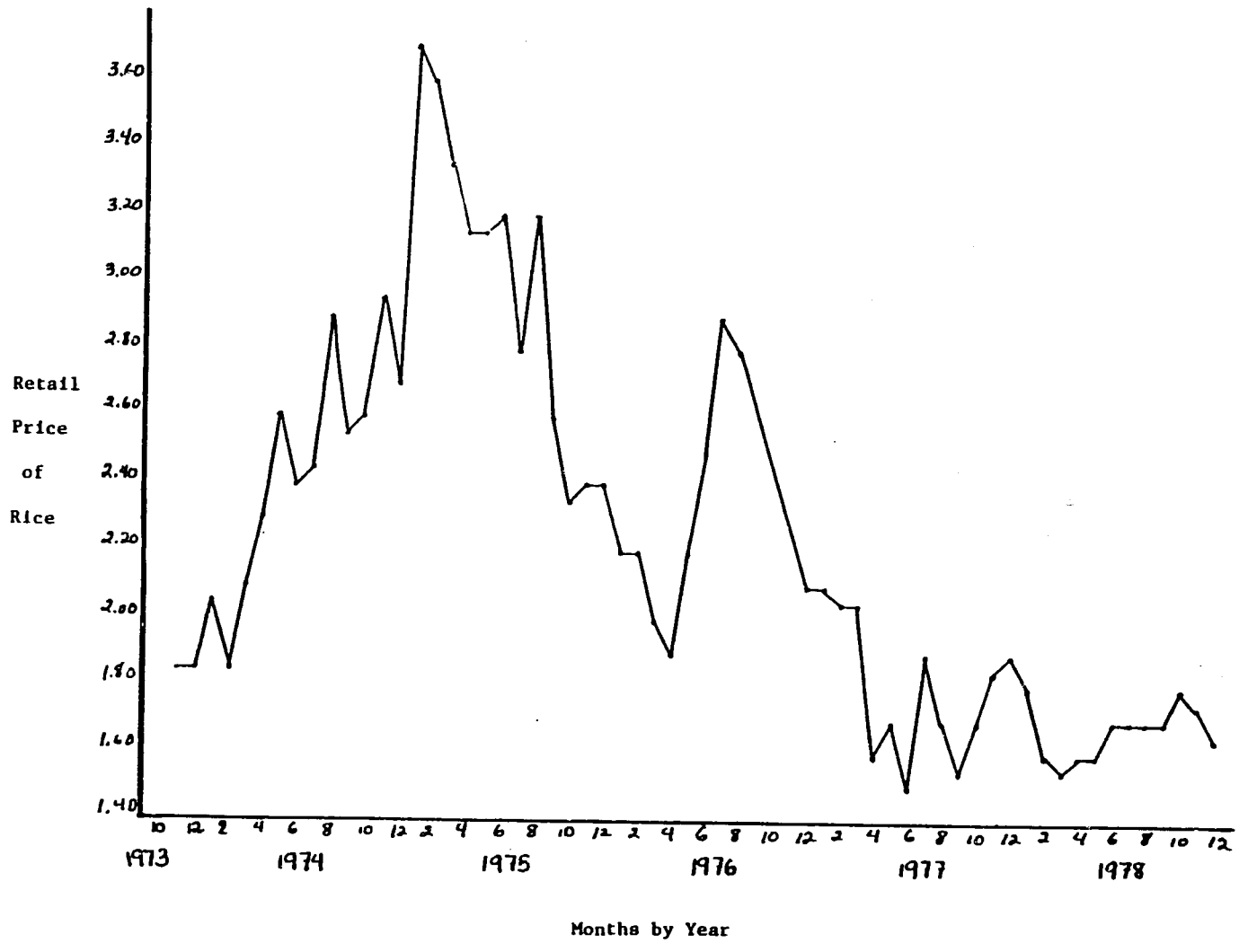
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Thirumalai												
1974:												
1975:			68 (10)	—	—	69 (12)	73 (13)	72 (15)	72 (13)	73 (16)	72 (16)	70 (22)
1976:	72 (21)	71 (27)	72 (22)	74 (28)	73 (32)	73 (32)	73 (36)	72 (37)	75 (46)	73 (47)	73 (50)	72 (50)
1977:	74 (58)	76 (67)	75 (71)	75 (72)	75 (73)	76 (71)	77 (77)	77 (74)				
Vattam												
1973:												85 (14)
1974:	84 (17)	82 (17)	82 (22)	80 (23)	78 (24)	74 (25)	73 (26)	70 (28)	70 (29)	70 (32)	71 (33)	70 (31)
1975:	70 (36)	70 (37)	69 (41)	71 (40)	68 (46)	70 (44)	69 (52)	69 (56)	70 (66)	70 (78)	69 (81)	70 (84)
1976:	72 (95)	71 (97)	69 (98)	72 (104)	74 (105)	76 (121)	75 (122)	77 (124)	76 (128)	76 (131)	76 (135)	76 (137)
1977:	75 (146)	75 (150)	75 (158)	75 (160)	74 (162)	73 (165)	73 (157)	73 (152)				
Mel-Manakudy:												
1974:					84 (10)	84 (10)	83 (11)	83 (11)	84 (13)	84 (19)	84 (20)	81 (21)
1975:	78 (22)	80 (26)	80 (30)	81 (37)	80 (40)	79 (39)	79 (42)	77 (44)	76 (41)	74 (47)	74 (48)	75 (52)
1976:	76 (58)	77 (55)	78 (61)	78 (60)	77 (65)	78 (67)	78 (68)	78 (70)	78 (76)	78 (75)	79 (82)	79 (82)
1977:	82 (100)	81 (109)	82 (113)	81 (113)	81 (118)	81 (117)	81 (107)	79 (75)				

APPENDIX VII

MATRIX OF AGE AT WEIGHING BY AGE OF ENTRY INTO THE C.H.D.P. SHOWING THE AVERAGE WEIGHT-FOR-AGE AS A PERCENT OF STANDARD (HARVARD), KOTTAR DATA

Age at Weighing \ Age at Entry into Program	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
00	95																																				
01	92	90																																			
02	87	85	85																																		
03	86	83	84	83																																	
04	89	81	81	80	82																																
05	88	81	80	79	81	81																															
06	89	79	79	78	78	79	80																														
07	88	78	78	77	76	78	78	77																													
08	86	77	77	76	75	76	76	75	77																												
09	84	76	75	75	74	76	74	74	75	74																											
10	82	75	75	75	73	75	73	73	74	73	72																										
11	81	75	74	74	73	74	73	74	75	73	72	76																									
12	80	74	74	74	72	74	73	73	74	72	70	75	75																								
13	80	75	74	74	72	74	73	73	73	73	72	75	74	72																							
14	80	74	74	74	73	74	73	73	74	73	73	76	75	73	73																						
15	78	74	74	74	73	74	73	73	73	74	72	76	74	72	74	76																					
16	78	73	74	73	72	74	73	72	72	72	73	75	74	73	72	75	72																				
17	78	73	74	73	72	74	73	72	73	71	71	75	73	73	71	75	73	74																			
18	77	73	74	73	72	73	72	72	73	72	71	75	73	74	71	74	72	73	75																		
19	79	72	73	73	72	73	73	71	72	72	72	73	73	74	72	74	72	73	74	74																	
20	78	73	73	73	73	72	72	71	72	72	72	73	73	73	71	74	73	73	75	74	72																
21	77	73	73	73	73	72	73	71	73	72	71	72	73	73	71	73	73	74	75	72	73	72															
22	76	73	73	74	73	73	73	71	72	72	71	71	74	74	71	73	70	72	75	72	73	72	69														
23	77	73	73	73	74	72	72	71	73	72	72	71	74	72	70	73	70	73	76	72	74	71	69	76													
24	76	72	73	73	73	71	73	71	73	71	72	71	73	74	69	72	71	73	76	70	73	72	68	76	73												
25	74	72	73	73	74	71	73	71	74	72	74	72	74	73	70	73	71	72	76	70	74	72	71	76	73	68											
26	74	72	73	73	73	71	72	71	73	72	72	72	73	74	68	72	71	72	77	69	74	71	67	80	74	71	70										
27	74	72	73	73	73	72	73	71	73	72	72	73	73	74	68	72	71	72	76	69	73	69	70	77	72	72	69	78									
28	75	72	73	73	73	72	73	70	74	72	72	72	73	74	68	74	71	71	77	69	66	69	70	76	73	72	67	76	69								
29	75	72	73	72	73	72	73	70	73	71	74	72	72	74	68	73	72	71	77	69	68	69	72	78	73	73	65	74	70	72							
30	76	72	73	73	73	72	73	70	73	71	74	71	74	73	67	74	72	71	76	68	68	73	73	75	73	74	67	67	72	66	65						
31	75	73	73	73	73	73	73	70	74	70	74	73	73	74	66	74	71	70	76	70	68	74	72	75	74	75	67	70	67	65	65	65					
32	77	73	74	74	73	72	72	71	74	70	75	75	74	73	69	73	73	70	75	71	66	74	74	76	75	74	67	70	71	68	67	65	60				
33	76	73	74	73	74	73	73	70	74	71	74	77	75	73	68	74	73	70	74	71	65	69	74	78	75	72	67	73	76	68	66	66	63	65			
34	76	73	74	73	75	72	72	70	75	70	75	76	75	72	69	73	72	70	75	70	64	70	73	80	75	70	67	74	72	69	68	65	63	69	66		
35	74	73	75	73	75	72	72	72	74	70	75	75	74	71	70	73	72	70	75	71	63	69	74	74	75	72	68	69	68	72	68	64	63	68	66	58	
36	76	72	75	73	74	72	74	72	73	71	76	72	73	73	69	75	72	72	74	70	64	71	71	72	76	72	67	71	71	69	70	62	65	58	66	58	74

APPENDIX VIII THE RETAIL PRICE OF RICE PER KILOGRAM IN KANYAKUMARI DISTRICT, 1973-1978



APPENDIX IX

THE CONTEXT OF MALNUTRITION: BIVARIATE DISTRIBUTIONS, KOTTAR DATA

REGION	3,556	76.0	45.5	3.9
Coast	858	75.8	48.7	5.1
Interior	2,698	76.0	44.5	3.6
Statistical significance		---	.05	.05
REGION: CATHOLICS ONLY	1,839	76.4	45.8	4.2
Coast	785	76.0	48.3	5.0
Interior	1,054	76.4	43.9	3.6
Statistical significance		---	.10	---

Note: Nutrition data in this appendix are based on the NCHS/CDC reference medians for weight-for-age. Statistical significance has been calculated using chi squares for % malnourished and % third degree, the F test for average % of standard based on analysis of variance when there are more than two categories, and the two-tailed T test for average % of standard when there are only two categories.

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
VILLAGE	3,556	76.0	45.5	3.9
Allanvilai	68	79.2	25.0	0
Colachel	103	74.5	50.5	5.8
En. Puthenthurai	119	70.4	69.7	12.6
Enayam	175	80.1	32.0	4.0
Kadiapatanam	129	71.8	67.4	4.7
Kalimar	201	76.5	42.3	3.0
Kandanvilai	213	75.7	43.7	4.7
Konamkadu	157	72.6	66.9	5.7
Kulasekaram	225	71.0	68.4	8.0
Mangnzhi	224	76.9	38.4	4.0
Mel-Manakudy	109	81.1	28.4	1.8
Melpalai	260	78.5	26.9	1.2
Midalam	119	74.1	58.8	5.0
Mulagumudu	197	77.0	39.6	2.0
Pallam	104	77.2	37.5	1.9
Palliady	296	78.0	36.5	2.7
Parakunnu	206	75.3	48.1	2.9
Puthukadai	139	73.8	60.4	2.9
Siluvaipuram	274	78.3	35.0	1.1
Thirumalai	74	77.5	41.9	5.4
Vattam	164	73.5	57.3	7.3
Statistical significance		---	.000	.000

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
SEX OF CHILD	3,555	76.0	45.5	3.9
Male	1,721	75.6	46.5	3.5
Female	1,834	76.3	44.5	4.3
Statistical significance		---	---	---
AGE OF CHILD	3,552	76.0	45.5	3.9
0 - 6 Months	285	82.0	26.7	3.5
7 - 12	544	77.9	36.6	4.4
13 - 18	589	75.6	44.3	4.6
19 - 24	602	75.3	47.7	2.5
25 - 30	563	74.8	49.2	5.3
31 - 36	431	75.6	49.4	1.6
37 - 42	285	74.0	55.1	3.9
43 - 48	177	73.9	56.5	5.1
49 - 54	66	72.9	56.1	6.1
55 - 60	10	68.4	80.0	10.0
Statistical significance			.000	.10

*Not ascertained

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
RELIGION	3,546	76.0	45.5	3.9
Hindu	1,063	75.6	46.0	4.5
Catholic	1,839	76.3	45.8	4.2
Other Christian	594	76.2	42.6	1.9
Muslim	50	72.8	56.0	6.0
Statistical significance		---	---	.05
CASTE	3,420	76.0	45.6	3.9
Nair	55	79.4	25.5	0
Nadar	2,046	75.9	45.6	3.5
Mukkuvar/Barathar	862	76.0	47.4	5.0
Asari	200	75.0	46.0	5.5
Vaniar/Kuyavar	73	77.1	42.5	4.1
Harijan	184	76.4	44.0	2.2
Statistical significance		---	.10	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
OCCUPATION	3,545	76.0	45.6	3.9
Farmer	73	77.6	35.6	2.7
Fisherman	698	76.0	48.1	4.4
Fishmonger	51	75.5	43.1	7.8
Palmyra Climber	288	76.1	44.1	3.1
Coolie Worker	1,619	75.7	46.2	4.1
Carpenter	63	74.9	50.8	3.2
Mason	207	76.6	45.4	1.9
Weaver	57	75.6	43.9	8.8
Merchant	112	78.2	39.3	1.8
Miscellaneous	139	75.2	48.2	6.5
Other	238	76.7	39.5	2.5
Statistical significance		---	---	---
INCOME: ANNUAL TOTAL	3,546	76.0	45.5	3.9
Rs. 500 or Less	25	74.1	44.0	8.0
Rs. 1,000	146	76.5	37.7	4.1
Rs. 1,500	714	75.6	45.2	4.2
Rs. 2,000	894	76.4	43.6	3.6
Rs. 2,500	613	75.8	46.5	3.1
Rs. 3,000	394	75.2	50.0	4.8
Rs. 5,000	568	76.5	44.0	4.4
Rs. 10,000	192	75.8	53.1	3.6
Statistical significance		---	.05	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
FOOD EXPENSE AS % OF TOTAL INCOME	3,039	76.0	45.4	4.0
0- 49	111	77.0	39.6	4.5
50- 60	263	76.6	43.3	3.8
61- 70	458	76.9	43.2	2.8
71-100	2,207	75.7	46.4	4.3
Statistical significance		---	---	---
FOOD EXPENSE AS % OF TOTAL EXPENSE	3,532	76.0	45.5	3.9
0- 25	7	80.6	28.6	0
26- 50	57	75.1	50.9	7.0
51- 75	919	76.2	45.6	3.6
76-100	2,549	75.9	45.4	4.0
Statistical significance		---	---	---
TOTAL EXPENSE AS % OF INCOME	3,519	76.0	45.6	3.9
0- 75	235	77.2	37.4	2.6
76- 90	567	76.2	46.2	4.9
91-100	1,132	76.4	45.1	3.3
Over 100	1,585	75.4	46.9	4.3
Statistical significance		---	.10	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
INDEBTEDNESS	3,556	76.0	45.5	3.9
Yes	2,780	76.0	45.5	3.7
No	776	75.9	45.5	4.6
Statistical significance		---	---	---
INDEBTEDNESS	3,556	76.0	45.5	3.9
More than Rs. 2,500	249	76.3	43.4	4.4
Rs. 1,000 - 2,500	538	76.4	44.2	3.3
Less Than Rs. 1,000	1,993	75.9	46.1	3.8
None	776	75.9	45.5	4.6
Statistical significance		---	---	---
SAVINGS	3,552	76.0	45.6	3.9
Yes	652	76.7	42.5	4.6
No	2,900	75.8	46.2	3.8
Statistical significance		---	.10	---
SAVINGS	3,490	75.9	45.8	4.0
More than Rs. 2,500	113	77.4	38.0	2.7
Less Than Rs. 1,000	477	76.2	45.3	5.2
None	2,900	75.8	46.2	3.8
Statistical significance		---	---	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
OWNERSHIP: LAND	3,556	76.0	45.5	3.9
Owned	1,928	75.9	45.1	3.7
Leased	46	76.0	54.3	2.2
Both	197	76.8	39.1	1.5
Neither	1,385	75.9	46.6	4.7
Statistical significance		---	---	---
OWNERSHIP: FARM ANIMALS	3,554	76.0	45.5	3.9
Yes	1,149	76.4	42.7	3.1
No	2,405	75.8	46.9	4.3
Statistical Significance		---	.05	.10
HOME OWNERSHIP	3,546	76.0	45.5	3.9
Own	3,361	75.9	45.8	3.9
Rent	185	76.9	41.1	4.9
Statistical significance		---	---	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
OWNERSHIP: LAND				
INTERIOR ONLY	2,698	76.0	44.5	3.6
0- 10 Cents	1,733	75.7	46.2	4.2
11- 25	519	76.3	43.4	2.3
26- 50	288	76.3	45.1	2.8
51- 75	71	78.7	25.4	0
76-100	58	79.6	31.0	1.7
101-200	21	76.5	28.6	9.5
201-500	8	77.1	37.5	0
Statistical significance		*	.01	.10
OWNERSHIP: WET LAND				
INTERIOR ONLY	2,698	76.0	44.5	3.6
0- 10 Cents	2,481	76.0	44.7	3.5
11- 25	148	76.1	43.2	3.4
26- 50	54	76.4	40.7	7.4
51- 75	10	79.6	30.0	0
76-100	4	78.1	25.0	0
101-200	1	85.7	0	0
Statistical significance		---	---	---
OWNERSHIP: DRY LAND				
INTERIOR ONLY	2,698	76.0	44.5	3.6
0- 10 Cents	1,866	75.7	46.3	4.2
11- 25	497	76.2	43.5	2.6
26- 50	231	77.9	37.2	.4
51- 75	43	78.5	25.6	0
76-100	45	77.2	37.8	6.7
101-200	12	77.9	33.3	0
201-500	4	75.4	50.0	0
Statistical significance			.05	.05

*Not ascertained

KOTTAR SOCIAL SERVICE SOCIETY

Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Stardard	% Malnourished	% Third Degree
EDUCATION: HEAD OF HOUSEHOLD	3,552	76.0	45.5	3.9
None	1,182	75.6	48.0	5.3
1 thru 3 Standard	552	76.1	45.5	2.9
4 & 5	1,142	76.0	45.3	3.9
6 thru 8	420	75.9	44.8	2.4
9 thru 11	256	78.0	36.3	2.3
Statistical significance		---	.05	.05
EDUCATION: MOTHER	3,454	76.1	45.4	3.9
None	1,245	75.4	48.0	5.5
1 thru 3 Standard	483	75.7	45.3	3.7
4 & 5	1,093	76.6	43.3	3.0
6 thru 8	412	76.0	47.8	2.9
9 thru 11	221	77.9	36.2	1.8
Statistical significance		.01	.01	.01
AGE OF MOTHER	3,524	76.0	45.4	3.9
15 to 20	7	81.4	42.9	0
21 to 25	328	77.3	36.6	3.7
26 to 30	1,119	77.1	41.5	2.1
31 to 35	1,051	75.7	46.2	4.2
36 to 40	691	74.8	51.4	5.6
41 to 60	328	74.0	52.1	6.1
Statistical Significance		.000	.000	.01

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
HOME: TYPE OF ROOF	3,538	76.0	45.6	4.0
Thatched	2,057	75.8	45.0	4.5
Tiled	1,481	76.1	46.5	3.2
Statistical significance		---	---	.10
HOME: TYPE OF WALLS	3,542	76.0	45.5	3.9
Stone	340	75.7	49.1	3.8
Mud	2,528	76.0	45.1	3.9
Hut	469	76.2	44.3	4.3
Other	205	76.1	47.8	2.9
Statistical significance		---	---	---
HOME: NUMBER OF ROOMS	3,532	76.0	45.4	3.9
One	763	76.0	45.1	4.7
Two	964	75.5	47.2	3.9
Three	957	76.2	44.6	4.1
Four to Nine	848	76.4	44.5	2.9
Statistical significance		---	---	---
HOME: NUMBER OF WINDOWS	3,525	76.0	45.4	3.9
None	1,266	75.9	44.8	4.3
One	388	74.6	50.8	4.9
Two	649	75.5	48.8	3.7
Three	425	76.5	42.1	3.3
Four	309	76.5	45.0	2.3
Five to Eight	488	77.2	41.2	3.9
Statistical significance		.01	.05	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
HOME: ELECTRICITY	3,526	76.0	45.5	3.9
Yes	239	77.0	41.4	3.3
No	3,287	75.9	45.8	3.9
Statistical significance		.10	---	---
WATER: SOURCE	3,545	76.0	45.4	3.9
In Compound	1,530	76.0	45.3	3.9
Within One Furlong	1,546	76.3	45.1	4.0
Over One Furlong	469	75.3	46.7	3.8
Statistical Significance		---	---	---
WATER: QUALITY	3,551	76.0	45.5	3.9
Good	3,053	76.0	45.5	3.7
Bad	498	76.2	45.6	5.4
Statistical significance		---	---	.10
SANITATION: LATRINES	3,549	76.0	45.4	3.9
Private	158	77.0	41.8	3.2
Common	130	75.0	47.7	6.9
None	3,261	76.0	45.5	3.8
Statistical significance		---	---	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
FAMILY TYPE	3,553	76.0	45.5	3.9
Joint	853	76.6	43.3	3.0
Nuclear	2,700	75.8	46.2	4.2
Statistical significance		.05	---	---
NUMBER OF FAMILIES IN HOUSE (JOINT FAMILIES)	3,553	76.0	45.5	3.9
One	2,700	75.8	46.2	4.2
Two	729	76.9	41.8	2.6
Three	100	75.6	46.0	6.0
Four	24	71.7	75.0	4.2
Statistical significance		.01	.01	---
FAMILY SIZE: NUMBER OF LIVE CHILDREN	3,556	76.0	45.5	3.9
One	517	77.7	39.3	2.1
Two	690	77.1	40.0	2.0
Three	730	76.4	44.0	3.0
Four	627	75.3	49.3	5.9
Five	442	75.2	48.2	5.2
Six or More	550	73.9	53.8	6.0
Statistical significance		.000	.000	.001

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
NUMBER OF ABORTIONS	3,556	76.0	45.5	3.9
None	3,339	76.0	45.2	3.9
One	158	76.4	48.1	5.7
Two or More	59	75.1	54.2	3.4
Statistical significance		---	---	---
NUMBER OF STILL BIRTHS	3,556	76.0	45.5	3.9
None	3,296	76.0	45.6	3.9
One	206	75.7	45.6	4.9
Two or More	54	76.6	38.9	5.6
Statistical significance		---	---	---
NUMBER OF PRESCHOOL AGE DEATHS	3,556	76.0	45.5	3.9
None	2,525	76.2	44.4	3.0
One	708	76.0	46.9	5.2
Two	221	73.8	51.1	10.0
Three or More	102	74.9	50.0	3.9
Statistical significance		---	---	.000
FAMILY PROBLEMS	3,547	76.0	45.5	3.9
None	2,869	76.0	45.0	3.9
Drinking	215	76.7	45.1	2.8
Quarrels	279	76.2	48.7	2.5
Physical Defect	44	76.0	36.4	6.8
Unemployment	60	73.0	58.3	8.3
Miscellaneous	80	74.9	46.3	7.5
Statistical significance		---	---	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
CHILD HEALTH: % OF TIME DIAGNOSED AS SICK	3,546	76.0	45.5	3.9
0 to 10%	201	80.6	28.9	3.0
11 to 20%	369	77.5	36.0	3.3
21 to 30%	527	76.0	44.6	3.2
31 to 40%	613	76.2	46.5	2.9
41 to 50%	671	75.2	47.7	4.0
51 to 60%	419	75.2	47.3	3.1
61 to 70%	325	75.2	49.2	5.8
71 to 80%	236	74.2	54.2	6.4
81 to 100%	185	75.3	52.4	5.9
Statistical significance		---	.000	---
CHILD HEALTH: INCIDENCE OF DIARRHEA, ETC.	3,546	76.0	45.5	3.9
0 to 10%	1,865	76.9	41.2	3.2
11 to 20%	922	75.1	50.2	4.4
21 to 40%	620	74.8	49.8	4.7
41 to 100%	139	74.7	53.2	6.5
Statistical significance		---	.000	.10
CHILD HEALTH: INCIDENCE OF FEVER, ETC.	3,546	76.0	45.5	3.9
0 to 10%	2,138	76.4	44.0	4.2
11 to 20%	844	75.8	46.3	2.8
21 to 40%	485	75.0	48.9	3.7
41 to 100%	79	73.5	58.2	7.6
Statistical significance		---	.05	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
CHILD HEALTH: INCIDENCE OF RESPIRATORY DISEASE	3,546	76.0	45.5	3.9
0 to 10%	1,571	76.4	44.5	4.0
11 to 20%	864	75.3	46.8	4.3
21 to 40%	771	76.1	45.7	3.4
41 to 100%	340	75.9	46.8	3.5
Statistical significance		---	---	---

IMMUNIZATION HISTORY: All Children

	N	% Standard	% MN	% Third Degree
TOTAL NUMBER OF IMMUNIZATIONS RECEIVED	3,549	76.0	45.6	3.9
0	151	80.9	31.8	6.6
1	466	75.9	47.4	7.1
2	798	75.6	45.7	4.5
3	1,425	76.1	43.6	2.7
4	634	75.2	50.2	3.0
5	75	74.7	57.3	5.3
Statistical significance		---	.001	.001

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
IMMUNIZATION: POLIO	3,555	76.0	45.5	3.9
Yes	2,769	75.8	45.9	3.1
No	786	76.8	44.0	6.7
Statistical significance		---	---	.000
IMMUNIZATION: CHOLERA	3,554	76.0	45.5	3.9
Yes	216	73.7	60.6	4.2
No	3,338	76.1	44.5	3.9
Statistical significance		---	.000	---
IMMUNIZATION: SMALLPOX	3,551	76.0	45.5	3.9
Yes	3,311	75.7	46.4	3.8
No	240	79.7	34.2	5.8
Statistical significance		---	.001	---
IMMUNIZATION: BCG	3,554	76.0	45.5	3.9
Yes	1,049	74.9	50.5	4.2
No	2,505	76.4	43.4	3.8
Statistical significance		---	.001	---

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
IMMUNIZATION: DPT	3,555	76.0	45.5	3.9
Yes	1,919	76.3	43.7	2.6
No	1,636	75.6	47.6	5.6
Statistical significance		---	.05	.000

IMMUNIZATION: DPT	3,555	76.0	45.5	3.9
None	1,636	75.6	47.6	5.6
One	437	77.1	41.4	2.3
Two	1,417	76.0	44.7	2.8
Three	65	77.2	36.9	0
Statistical significance		---	.05	.001

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
IMMUNIZATION HISTORY*: Children 13 Months and Older				
POLIO	2,722	75.0	49.2	3.8
Yes	2,428	75.3	48.2	3.1
No	294	72.7	57.5	9.9
Statistical significance		---	.005	.000
CHOLERA	2,721	75.0	49.2	3.8
Yes	216	73.7	60.6	4.2
No	2,505	75.1	48.3	3.8
Statistical significance		.05	.001	---
SMALLPOX	2,718	75.0	49.3	3.8
Yes	2,657	75.0	49.3	3.8
No	61	75.2	49.2	4.9
Statistical significance		---	---	---
BCG	2,721	75.0	49.2	3.8
Yes	915	74.6	52.2	4.2
No	1,806	75.2	47.7	3.7
Statistical significance		.10	.05	---

*Infants (Children under 13 months of age) omitted

KOTTAR SOCIAL SERVICE SOCIETY
Sample of Children in the Community Health Development Project
Weight Data from July 1977

	Number of Children	Average % of Standard	% Malnourished	% Third Degree
IMMUNIZATION HISTORY*: Children 13 Months and Older				
DPT	2,722	75.0	49.2	3.8
Yes	1,659	75.8	45.8	2.4
No	1,063	73.7	54.6	6.0
Statistical significance		---	.000	.000
DPT	2,722	75.0	49.2	3.8
None	1,063	73.7	54.6	6.0
One	319	76.0	47.0	2.5
Two	1,278	75.7	46.0	2.5
Three	62	77.4	35.5	0
Statistical significance		---	.000	.000

*Infants (Children under 13 months of age) omitted

APPENDIX X

MALNUTRITION IN RELATION TO FATHER'S EDUCATION AND MOTHER'S EDUCATION COMBINED, KOTTAR DATA

MOTHER'S EDUCATION \ FATHER'S EDUCATION		(1,305) None	(613) 1-3	(406) 4	(904) 5	(487) 6-8	(297) 9-11	(4,012) Total
				Average % of Standard				
None	(1,438)	74.9	76.6	75.0	76.2	74.9	76.3	75.4
1-3	(553)	75.8	76.1	75.0	75.8	75.4	75.0	75.8
4	(434)	76.9	76.1	73.8	75.8	76.1	76.7	75.9
5	(837)	77.5	76.4	75.5	77.2	76.6	77.9	76.9
6-8	(492)	74.6	75.5	75.5	76.2	76.5	77.8	76.0
9-11	(258)	77.1	77.3	73.6	78.5	76.1	79.9	77.9
Total	(4,012)	74.8	76.3	74.9	76.5	75.7	76.9	
				% Malnourished				
None		50.7	44.7	46.5	43.4	50.6	40.5	48.1
1-3		44.9	43.3	50.0	44.8	47.4	50.0	45.3
4		45.5	39.4	52.3	48.1	39.5	43.5	45.3
5		40.4	48.9	49.4	39.4	42.5	35.8	42.1
6-8		56.7	49.3	51.1	47.5	44.0	36.5	47.7
9-11		34.6	48.0	71.4	26.8	39.0	29.7	36.2
Total		46.9	45.6	50.4	42.7	45.7	40.0	
				% Third Degree				
None		6.3	3.3	10.1	3.4	3.5	5.4	5.2
1-3		7.1	1.6	2.3	3.4	3.5	0	3.7
4		2.0	3.0	4.6	3.8	2.3	4.3	3.2
5		2.0	3.3	6.5	3.5	.9	1.9	2.9
6-8		7.5	2.7	2.2	1.0	2.7	1.9	2.9
9-11		3.8	0	7.1	0	2.4	1.4	1.8
Total		5.0	2.7	6.5	3.0	2.7	4.7	

Note: Nutrition data in this appendix are based on the NCHS/CDC reference medians for weight-for-age. Levels of education shown refer to standard of schooling attained. Figures in parentheses are the number of children in each row or column.

APPENDIX XI

MALNUTRITION IN RELATION TO "LIVING CONDITIONS" (TWO SCALES), KOTTAR DATA

The first scale identifies the "best" living conditions revealed in the Kottar data and successive departures from "best." It is a simple additive scale consisting of the following four attributes. Figures in parentheses refer to prevalence in the sample.

The "Best" Living Conditions

1. Tile roof on house (42%) and stone walls (9%)
2. Four rooms or more (23%) and four windows or more (23%)
3. Electricity in the house (7%)
4. Private latrine(s) (5%)

Featured in this scale are the best construction, large size (implying modern functional specificity of rooms), and modern amenities. The scale ranges from all four of the features indicated to none of the four. This is the most advantaged polarity of the living conditions continuum.

The second scale identifies the "worst" living conditions revealed in the Kottar data and successive departures from "worst." It too, is a simple additive scale which differs from the previous scale in possessing five attributes, with values ranging from all five to none of the five. This scale addresses the most deprived polarity of the living conditions continuum.

The "Worst" Living Conditions

1. Thatched roof on house (58%) and "hut" walls (43%)
2. One room (22%) and no windows (36%)
3. No electricity in the house (93%)
4. No latrines, public or private (92%)
5. Water source more than a furlong from the house (13%)

LIVING CONDITIONS AND MALNUTRITION

	Number of Children	NUTRITION INDICATORS: Average % of Standard	% Malnourished	% Third Degree
LIVING CONDITIONS: BEST SCALE	3,556	76.0	45.5	3.9
Best = 4	6	83.1	33.3	0
3	54	75.6	51.9	1.9
2	192	76.5	43.2	3.6
1	612	76.7	42.6	3.3
0	2,692	75.8	46.2	4.2
Statistical significance		----	----	---
LIVING CONDITIONS: WORST SCALE	3,556	76.0	45.5	3.9
0	57	78.4	33.3	5.3
1	352	75.9	45.7	4.0
2	2,118	76.0	45.9	3.9
3	650	75.5	46.3	3.7
4	336	76.9	42.9	3.9
Worst = 5	43	74.1	48.8	7.0
Statistical significance		----	----	---

Note: The nutrition values shown reflect the NCHS/CDC reference medians for weight-for-age.

APPENDIX XII

MALNUTRITION IN RELATION TO MOTHER'S AGE AND THE NUMBER OF CHILDREN ALIVE IN THE FAMILY, KOTTAR DATA

MOTHER'S AGE \ NUMBER OF CHILDREN ALIVE		(513) One	(1,406) 2-3	(1,062) 4-5	(543) 6-15	(3,524) Total
		Average % of Standard				
15-25	(335)	78.3	75.9	74.8	79.1	77.3
26-30	(1,119)	77.3	77.0	77.3	77.9	77.1
31-35	(1,051)	78.1	76.5	74.9	74.9	75.7
36-40	(691)	74.9	77.0	74.8	74.8	74.8
41-60	(328)	71.2	74.9	75.0	73.6	74.1
Total	(3,524)	76.5	76.5	75.6	76.1	76.0
		% Malnourished				
15-25		33.7	41.3	50.0	0	36.7
26-30		43.0	40.3	44.3	42.9	41.5
31-35		34.0	45.0	48.3	48.3	46.2
36-40		70.0	41.4	51.2	55.7	51.4
41-60		66.7	41.7	50.0	53.6	52.1
Total		46.9	42.1	47.9	[illegible].9	
		% Third Degree				
15-25		4.0	3.2	0	0	3.6
26-30		.8	2.4	3.2	0	2.1
31-35		2.1	2.0	6.4	4.5	4.2
36-40		0	4.3	5.8	6.3	5.6
41-60		0	0	5.8	6.7	6.1
Total		1.3	2.5	4.6	3.2	

Note: Nutrition data in this appendix are based on the NCHS/CDC reference medians for weight-for-age. Levels of education shown refer to standard of schooling attained. Figures in parentheses are the number of children in each row or column.

APPENDIX XIII

MULTIVARIATE ANALYSIS OF KOTTAR DATA USING LEAST SQUARES REGRESSION

This appendix presents the computer output for each of the four models described in Section IV of this report. The following variable definitions and labels apply for all four models.

	PIWS. 77	=	Nutritional status in July 1977
(1)	AGEMO. 77	=	Child age in months in July 1977
(2)	AG.SG. 77	=	the square of child age in months in July 1977
(3)	PIWS.F	=	Weight/Weight (age) at first observation
(4)	P.HOS.SK	=	Ratio of reported diarrhea occurrences to the total number of observations
(4a)	P.DIAR	=	Ratio of reported diarrhea occurrences to the total number of observations
(4b)	P.FEVER	=	Ratio of reported fever occurrences to the total number of observations.
(5)	NO.SIBS	=	Number of children in the family
(6)	DSX.FIST	=	Sex of child
(7)	INC.TOT	=	Family income
(8)	SCHOO.HH	=	Education of the head of household
(9)	TOT.LAND	=	Total land available
(10)	AMT.DEBT	=	Amount of family debt
(11)	DVT,IISI	=	Village type

Each of the four models was run with two sets of data; (1) the entire set of children for which there was complete information and (2) children who had been weighed first prior to their third month of life.

MODEL I

LEAST SQUARES REGRESSION TABLE 4.9.

ANALYSIS OF VARIANCE OF 588.PIWS.77 N=.3543 OUT OF 4133

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	6	.11446 +6	19076.	198.35	0.
ERROR	3536	.34007 +6	96.174		
TOTAL	3542	.45453 +6			

MULT R= .50181 R-SQR= .25182 SE= 9.8068

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		76.920	1.2286	62.611	0.
586.AGEMO.77	-.16010	-.50016	.51839 -1	-9.6446	.0000
5863.AG.SQ.77	.15269	.92088 -2	.10023 -2	9.1874	.0000
473.PIWS.F	.43024	.26805	.94580 -2	28.341	0.
780.P.HOS.SK	-.12819	-5.8260	.75798	-7.6861	.0000
4221.NO.SIBS	-.10964	-.57538	.87720 -1	-6.5592	.0000
4602.DSX.FISI	-.16660	-3.3384	.33226	-10.047	.0000

MODEL II

LEAST SQUARES REGRESSION TABLE 4.10

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 3543 OUT OF 4133

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	7	.11353 +6	16219.	168.14	0.
ERROR	3535	.34100 +6	96.463		
TOTAL	3542	.45453 +6			

MULT R= .49978 R-SQR= .24978 SE= 9.8216

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		75.676	1.1976	63.191	0.
586.AGEMO.77	-.15531	-.48720	.52120 -1	-9.3478	.0000
5863.AG.SQ.77	.15080	.91256 -2	.10061 -2	9.0699	.0000
473.PIWS.F	.42917	.26767	.94748 -2	28.251	0.
782.P.DIAR	-.08864	-6.7131	1.2688	-5.2911	.0000
783.P.FEVER	-.06990	-6.0975	1.4636	-4.1663	.0000
4221.NO.SIBS.	-.10868	-.57172	.87955 -1	-6.5001	.0000
4602.DSX.FISI	-.16524	-3.3153	.33281	-9.9616	.0000

MODEL III

LEAST SQUARES REGRESSION TABLE 4.11

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 3539 OUT OF 4133

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	11	.11841 +6	10764.	113.11	0.
ERROR	3527	.33565 +6	95.166		
TOTAL	3538	.45406 +6			

MULT R= .51066 R-SQR= .26077 SE= 9.7553

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		73.852	1.3589	54.347	0.
586.AGEMO.77	-.16824	-.52499	.51756 -1	-10.136	.0000
5863.AG.SQ.77	.15951	.95934 -2	.99975 -3	9.5958	.0000
473.PIWS.F	.43436	.27120	.94695 -2	28.639	0.
780.P.HOS.SK	-.12739	-5.7631	.75558	-7.6273	.0000
4221.NO.SIBS	-.12063	-.67901	.94089 -1	-7.2167	.0000
4602.CSX.FISI	-.16498	-3.2882	.33059	-9.9343	.0000
448.INC.TOT	.05543	.49205 -3	.14924 -3	3.2971	.0010
4162.SCHOO.HH	.01020	.32437 -1	.53565 -1	.60557	.5448
4352.TOT.LAND	.03846	.13927 -1	.60931 -2	2.2858	.0223
4521.AMT.DEBT	.00828	.52551 -4	.10682 -3	.49198	.6228
4012.OVT.IISI	.08196	2.4347	.49851	4.8841	.0000

MODEL IV

LEAST SQUARES REGRESSION TABLE 4.12

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 3539 OUT OF 4133

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	12	.11800 +6	9833.6	103.18	0.
ERROR	3526	.33606 +6	95.308		
TOTAL	3538	.45406 +6			

MULT R= .50979 R-SQR= .25989 SE= 9.7626

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		72.663	1.3309	54.596	0.
586.AGEMO.77	-.16384	-.51263	.51979 -1	-9.8622	.0000
5863.AG.SQ.77	.15764	.95009 -2	.10023 -2	9.4793	.0000
473.PIWS.F	.43430	.27131	.94765 -2	28.630	0.
782.P.DIAR	-.09191	-6.9353	1.2654	-5.4805	.0000
783.P.FEVER	-.07486	-6.5219	1.4631	-4.4575	.0000
4221.NO.SIBS	-.11790	-.66413	.94203 -1	-7.0500	.0000
4602.OSX.FISI	-.16356	-3.2614	.33128	-9.8450	.0000
448.INC.TOT	.04862	.43243 -3	.14962.-3	2.8902	.0039
4162.SCHOO.HH	.00886	.28213 -1	.53613 -1	.52623	.5988
4352.TOT.LAND	.04143	.15005 -1	.60943 -2	2.4621	.0139
4521.AMT.DEBT	.00983	.62460 -4	.10696 -3	.58395	.5593
4012.OVT.IISI	.08672	2.5831	.49971	5.1691	.0000

MODEL I - Using Children Weighed First Prior to Their Third Month of Life

LEAST SQUARES REGRESSION TABLE 4.13

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 1439 OUT OF 1614

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	6	51113.	8518.8	85.244	0.
ERROR	1432	.14311 +6	99.934		
TOTAL	1438	.19422 +6			

MULT R= .51300 R-SQR= .26317 SE= 9.9967

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		81.339	1.7841	45.590	0.
586.AGEMO.77	-.24172	-.83755	.88850 -1	-9.4265	.0000
5863.AG.SQ.77	.20138	.15386 -1	.19776 -2	7.7801	.0000
473.PIWS.F	.42121	.24775	.14097 -1	17.574	.0000
780.P.HOS.SK	-.11607	-5.4613	1.2349	-4.4223	.0000
4221.NO.SIBS	-.09029	-.47340	.13759	-3.4306	.0006
4602.OSX.FIS1	-.18724	-3.8202	.52963	-7.2130	.0000

MODEL II - Using Children Weighed First Prior to Their Third Month of Life

LEAST SQUARES REGRESSION TABLE 4.14.

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 1439 OUT OF 1614

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	7	51494.	7356.3	73.757	0.
ERROR	1431	.14272 +6	99.737		
TOTAL	1438	.19422 +6			

MULT R= .51491 R-SQR= .26513 SE= 9.9869

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		80.783	1.7552	46.024	0.
586.AGEMO.77	-.24065	-.83257	.88770 -1	-9.3789	.0000
5863.AG.SQ.77	.20341	.15477 -1	.19694 -2	7.8590	.0000
473.PIWS.F	.41911	.24607	.14092 -1	17.462	.0000
782.P.DIAR	-.09051	-7.4244	2.1596	-3.4379	.0006
783.P.FEVER	-.08328	-7.6968	2.4347	-3.1613	.0016
4221.NO.SIBS	-.09413	-.49330	.13793	-3.5766	.0004
4602.OSX.FIS1	-.18927	-3.8593	.52926	-7.2918	.0000

MODEL III - Using Only Children Weighed First Prior to Their Third Month of Life

LEAST SQUARES REGRESSION TABLE 4.15

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 1436 OUT OF 1614

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	11	52214.	4746.7	47.769	0.
ERROR	1424	.14150 +6	99.367		
TOTAL	1435	.19371 +6			

MULT R= .51918 R-SQR= .26954 SE= 9.9683

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		79.606	1.9699	40.412	0.
586.AGEMO.77	-.24830	-.86379	.89300 -1	-9.6729	.0000
5863.AG.SQ.77	.20739	.15884 -1	.19855 -2	8.0002	.0000
473.PIWS.F	.41989	.24664	.14127 -1	17.459	.0000
780.P.HOS.SK	-.11134	-5.2232	1.2354	-4.2279	.0000
4221.NO.SIBS	-.09857	-.55756	.14916	-3.7379	.0002
4602.OSX.FIS1	-.18337	-3.7298	.52989	-7.0389	.0000
448.INC.TOT	.03856	.34704 -3	.23934 -3	1.4561	.1456
4162.SCHOO.HH	.02887	.95785 -1	.87500 -1	1.0897	.2760
4352.TOT.LAND	.04934	.19583 -1	.10505 -1	1.8642	.0625
4521.AMT.DEBT	.02033	.12319 -3	.16052 -3	.76744	.4429
4012.OVT.IIS1	.03644	1.0373	.75380	1.3760	.1690

MODEL IV - Using Only Children Weighed First Prior to Their Third Month of Life

LEAST SQUARES REGRESSION TABLE 4.16

ANALYSIS OF VARIANCE OF 588.PIWS.77 N= 1436 OUT OF 1614

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	12	52745.	4395.4	44.369	0.
ERROR	1423	.14097 +6	99.064		
TOTAL	1435	.19371 +6			

MULT R= .52181 R-SQR= .27228 SE= 9.9531

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		79.050	1.9397	40.754	0.
586.AGEMO.77	-.24811	-.86046	.89060 -1	-9.6615	.0000
5863.AG.SQ.77	.20996	.15990 -1	.19740 -2	8.1006	.0000
473.PIWS.F	.41866	.24542	.14112 -1	17.391	.0000
782.P.DIAR	-.08861	-7.2455	2.1592	-3.3557	.0008
783.P.FEVER	-.08560	-7.9302	2.4468	-3.2411	.0012
4221.NO.SIBS	-.09962	-.56250	.14894	-3.7767	.0002
4602.OSX.FIS1	-.18529	-3.7644	.52925	-7.1128	.0000
448.INC.TOT	.03252	.29293 -3	.23064 -3	1.2275	.2198
4162.SCHOO.HH	.02971	.98362 -1	.87735 -1	1.1211	.2624
4352.TOT.LAND	.04871	.19297 -1	.10490 -1	1.8395	.0660
4521.AMT.DEBT	.02149	.13001 -3	.16035 -3	.81075	.4176
4012.OVT.IIS1	.04423	1.2592	.75399	1.6701	.0951

APPENDIX XIV

THE KOTTAR CODING FORM

File No. _____

KOTTAR SOCIAL SERVICE SOCIETY

Analysis of Growth, Health, and SES Data
in Cooperation with the
International Nutrition Policy and Planning Program, MIT
on a Grant From
The Rockefeller Foundation

CODING FORM

AUGUST — SEPTEMBER 1977

Welfare Centre No. _____

Family No. _____

WELFARE CENTRE CODES (00)

[Question *1]

COLACHEL	= 01	MELPALAI	= 12
EN. PUTHENTHURAI	= 02	MIDALAM	= 13
ENAYAM	= 03	MULAGUMUDU	= 14
KADIAPATANAM	= 04	PALLAM	= 15
KALIMAR	= 05	PALLIADY	= 16
KANDANVILAI	= 06	PARAKUNNU	= 17
KONANKADU	= 07	PUTHUKADAI	= 18
KOTOORCONAM	= 08	SILUVAIPURAM	= 19
KULASEKARAM	= 09	THIRUMALAI	= 20
MANGUZHI	= 10	VATTAM	= 21
MEL - MANAKUDY	= 11		

Welfare Centre ———

Family Number ——

I. INFORMATION FROM WEIGHT CHART

			Col. No. Card 1
1. Welfare Centre (00):	(See code, p. 1A)	——	2 — 3
2. Family Number (0000):		—— ——	4 — 7
3. Sex (0):	Male = 1 Female = 2	——	8
4. Date of Birth: (If not recorded enter 9's)	Month (00)	—— ——	9 — 10
	Year (0) — Last number	——	11
5. Date of Termination under CRS Applied Nutrition Programme:	Month (00)	—— ——	12 — 13
	Year (0)	——	14

HEALTH CODES

(Question #6)

a) Health: yes - no (0)	Yes, child hospitalized	= 1
	Yes, child sick	= 2
	No, child not sick	= 0
b) Health: type (0) (If none, leave blank)	Respiratory diseases: cough, bronchitis, pneumonia, etc.	= 1
	Diarrhea, dysentery, cholera	= 2
	Fever, including typoid, malaria	= 3
	Measles, chicken pox	= 4
	Whooping cough	= 5
	Skin infections: scabies, abscesses, etc.	= 6
	Parasites: hookworm, ascaris, etc.	= 7
	Tuberculosis	= 8
	Polio	= 9
	Secondary Nutritional Deficiencies (eye infections, rickets, stomatitis, glucitis)	= 0

6. HEALTH AND WEIGHT RECORD (See code P. 4)

Welfare Centre ——
Family Number ——

Entry Numbers

	1	2	3	4	5	6	7	8	9	10
Year (last number)										
Month (00)										
Weight (000)										
a) Health: yes-no (0)										
b) Health: Type (0)										
b) Health: Type (0)										
Col. No.	15–23	24–32	33–41	42–50	51–59	60–68	69–77	Card *2 8–16	17–25	26–34

	11	12	13	14	15	16	17	18	19	20
Year (last number)										
Month (00)										
Weight (000)										
a) Health: yes-no (0)										
b) Health: Type (0)										
b) Health: Type (0)										
Col. No.	35–43	44–52	53–61	62–70	71–79	Card *3 8–16	17–25	26–34	35–43	44–52

	21	22	23	24	25	26	27	28	29	30
Year (last number)										
Month (00)										
Weight (000)										
a) Health: yes-no (0)										
b) Health; Type (0)										
b) Health; Type (0)										
Col. No.	53–61	62–70	71–79	Card *4 8–16	17–25	26–34	35–43	44–52	53–61	62–70

HEALTH CODES

(Question # 6 Cont'd)

a) Health: Yes – no	Yes, child hospitalized	= 1
	Yes, child sick	= 2
	No, child not sick	= 0
b) Health: type (If none, leave blank)	Respiratory diseases: cough, bronchitis, pneumonia, etc.	= 1
	Diarrhea, dysentery, cholera	= 2
	Fever, including typhoid, malaria	= 3
	Measles, chicken pox	= 4
	Whooping cough	= 5
	Skin infections: scabies, abscesses, etc.	= 6
	Parasites: hookworm, ascaris, etc.	= 7
	Tuberculosis	= 8
	Polio	= 9
	Secondary Nutritional Deficiencies (eye infections, rickets, stomatitis, glucitis)	= 0

Welfare Centre ———
Family Number ———

6. HEALTH AND WEIGHT RECORD (Cont'd.) (see code, P. 6)

Entry Numbers

	31	32	33	34	35	36	37	38	39	40
Year (last number)										
Month (00)										
Weight (000)										
a) Health: yes-no (0)										
b) Health: Type (0)										
b) Health: Type (0)										
Col. No.	71-79	Card *5 8-16	17-25	26-34	35-43	44-52	53-61	62-70	71-79	Card *6 8-16

	41	42	43	44	45	46	47	48
Year (last number)								
Month (00)								
Weight (000)								
a) Health: yes-no (0)								
b) Health: Type (0)								
b) Health: Type (0)								
Col. No.	17-25	26-34	35-43	44-52	53-61	62-70	71-79	Card *7 8-16

		Col. No. Card *7
7. Date of Last weight entry: Month (00)	— —	17—18
Year (0)	—	19

IMMUNISATION CODES
(Question *8)

a) Doses Given (0):

None = 0
One = 1
Two = 2
Three = 3
Not Recorded = 9

COMMUNITY / CREED CODES
(Question *9)

a) Community

Nairs	= 1
Vellalas	= 2
Nadars	= 3
Mukkuvars/Barathars	= 4
Asaris (Illavars, Muthaliar, Kuruppu, Panikar)	= 5
Vaniars/Kuyavars	= 6
Harijans (Parayan, Pulayar, Sambavor)	= 7
Others	= 8
Not Recorded	= 9
Not Applicable	= 0

b) Creed

Hindu	= 1
Catholic	= 2
Other Christian	= 3
Muslim	= 4

Welfare Centre ——

Family Number ——

Col. No.
Card #7

8. IMMUNISATIONS: (See code, P. 4A)

Immunisations	(a) Doses Given (0)	b) Dates Given						
		1st Dose		2nd Dose		3rd Dose		
		Month (00)	Year (0)	Month (00)	Year (0)	Month (00)	Year (0)	
Smallpox								20 26
D P T.								27—36
B. C. G.								37—40
Polio								41—50
Cholera								51—60

II. INFORMATION FROM KSSS COMMUNITY HEALTH PROJECT FAMILY HEALTH RECORD

9. Community / Creed (00): (gee codes, P. 4A)

a) Community (0) —— 61

b) Creed (0) —— 62

HEAD OF HOUSE HOLD CODE

(Question * 11)

Father	= 1
Mother	= 2
Grand Father	= 3
Uncle	= 4
Eldest son	= 5
Eldest Daughter	= 6
Other	= 7

OCCUPATION CODE

(Question ' 12)

Blacksmith	= 01	Mason	= 11
Carpenter	= 02	Merchant / shopkeeper	= 12
Factory worker	= 03	Palmyrah climber	= 13
Farmer	= 04	Potter	= 14
Fisher man	= 05	Rubber Tapper	= 15
Fish monger	= 06	Tailor	= 16
Goldsmith	= 07	Teacher	= 17
Government Employee	= 08	Weaver	= 18
House keeper	= 09	Other	= 19
Landless Labourer / coolie worker	= 10	Not Recorded	= 99

Welfare Centre ——
Family Number ——

10. Joint Family in House:

a) Yes = 1
No = 0
Not Recorded = 9 — a) —— — Col. No Card *7: 63

b) If yes, Number of Families in House (0) : — b) —— — 64

c) If yes, Number of Persons per Family

Fam. *1 (00)	Fam. *2 (00)	Fam. *3 (00)	Fam. *4 (00)	Col. No Card *7
— —	— —	— —	— —	65–72

11. Who is Head of the Household? (0) (see code, P. 5A) —— — 73

12. Occupation of Head of Household (00) : (See code, P. 5A) — — — 74–75

13. Schooling of Head of Household (Standard attained) (00) :

Nil = 00
Not Recorded = 99 — — — 76–77

OCCUPATION CODE

(Question * 15)

Blacksmith	= 01	Mason	= 11
Carpenter	= 02	Merchant / shopkeeper	= 12
Factory worker	= 03	Palmyrah climber	= 13
Farmer	= 04	Potter	= 14
Fisher man	= 05	Rubber Tapper	= 15
Fish monger	= 06	Tailor	= 16
Goldsmith	= 07	Teacher	= 17
Government Employee	= 08	Weaver	= 18
House keeper	= 09	Other	= 19
Landless Labourer / coolie worker	= 10	Not recorded	= 99

Welfare Centre ———

Family Number ———

		Col. No.
14. Mother's year of Birth (Last Two Numbers) (00):	— —	78–79
15. Mother's Occupation (unless recorded as Head of Household) — (see code, p. 6A):	— —	Cand * 8 8–9
16 Mother's schooling (standard attained): Nil = 00; Not Recorded = 99	— —	10–11
17. Number of Children (00):	— —	12–13

18. Brothers and Sisters (If none, leave blank):

	Year of Birth (00) (Last two numbers)		Sex (0) Male = 1; Female = 2; Not recorded = 9	Col. No.
First *	—	—	—	14–16
Second	—	—	—	17–19
Third	—	—	—	20–22
Fourth	—	—	—	23–25
Fifth	—	—	—	26–28
Sixth	—	—	—	29–31
Seventh	—	—	—	32–34
Eighth	—	—	—	35–37
Ninth	—	—	—	38–40
Tenth	—	—	—	41–43

* If more than 10 brothers and sisters, drop eldest child or children

Welfare centre ———

Family Number ———

			Col No. Card #8
19. Number of Pregnancies (00): Not recorded = 99	— —		44 — 45
20. Number of Children Alive (00): Not recorded = 99	— —		46 — 47
21. Number of: (None = 0)			
a) Abortions	a)	—	48
b) Still births	b)	—	49
c) Infants died	c)	—	50
22. House:			
a) Ownership (0) Own = 1, Rented = 2, Not recorded = 9	a)	—	51
b) Roof (0) Thatched = 1, Tiled = 2, Other = 3, Not recorded = 9	b)	—	52
c) Walls (0) Stone = 1, Mud = 2, Hut = 3, Other = 4, Not recorded = 9	c)	—	53
d) Total Number of Rooms (0): Not recorded = 9	d)	—	54
e) Number of Windows (0): Not recorded = 9	e)	—	55
f) Electrified (0): Yes = 1, No = 2, Not recorded = 9	f)	—	56

Welfare Centre ——

Family Number ——

			Col No. Card *8
23. Sanitation:			
a) Distance to Drinking Water Source (0)			
In the compound	= 1		
Close to house (within one furlong)	= 2		
More than one furlong	= 3		
Not recorded	= 9	a) —	57
b) Hygienic condition of water (0)			
Good (protected water or open well)	= 1		
Bad (Tank or river)	= 2		
Not recorded	= 9	b) —	58
c) Latrine Facilities (0)			
Yes, private	= 1		
Yes, common	= 2		
No	= 0		
Not recorded	= 9	c) —	59
24 Land:			
a) Ownership (0):			
None	= 0		
Owned	= 1		
Leased from somebody	= 2		
Not recorded	= 9	d) —	60
b) Amount (cents): (Not recorded = 999)			
Owned: wet (000)		— — —	61 — 63
dry (000)		— — —	64 — 66
Leased: wet (000)		— — —	67 — 69
dry (000)		— — —	70 — 72

Welfare Centre ———

Family Number ———

					Col. No. Card * 8
25. Farm Animals Owned:					
a) Yes—No (0):	Yes	= 1			
	No	= 0			
	Not recorded	= 9	a)	—	73
b) If yes, Number by type (00):					
	Chicken		—	—	74 — 75
	Goat		—	—	76 — 77
	Cow		—	—	78 — 79
					Card * 9
	Ox		—	—	8 — 9
	Water Buffalo		—	—	10 — 11
	Pig		—	—	12 — 13
	Other		—	—	14 — 15
26. Boat Owned: Yes—No (0):					
	Yes	= 1			
	Owned by Sangam	= 2			
	No	= 0			
	Not recorded	= 9		—	16
27. Catamarans: Number Owned (0):					
	None	= 0			
	Yes	= 1-8			
	Not recorded	= 9		—	17

Welfare Centre ———
Family Number ——

									Col. No Card *9
28. Net Owned:									
a) Yes — No (0):	Yes	= 1							
	No	= 0							
	Not recorded	= 9						—	18
b) If Yes, Number by Type (0)									
	Nylon	= 1-8							
	Cotton	= 1-8							
	Not recorded	= 9						—	19
29. Annual Income: (Not recorded = 99999)	Work	(00000)	—	—	—	—	—		20—24
	Land	(00000)	—	—	—	—	—		25—29
	Other Sources	(00000)	—	—	—	—	—		30—34
	Total	(00000)	—	—	—	—	—		35—39
30. Annual Expenses: (Not recorded = 99999)	Food	(00000)	—	—	—	—	—		40—44
	Total	(00000)	—	—	—	—	—		45—49
31. Debts:									
a) Yes — No (0):	Yes	= 1							
	No	= 0							
	Not recorded	= 9						a) —	50
b) If Yes, Amount (00000):			b)	—	—	—	—	—	51—55

REASON FOR DEBT CODE
(Question * 31 d)

Education	=	1
Marriage / Jewellery	=	2
Sickness	=	3
House construction	=	4
Loss in business	=	5
Celebration	=	6
Business needs	=	7
Other	=	8
Not recorded	=	

SOCIAL PROBLEMS OF FAMILY CODE
(Question * 34)

Nil	=	0
Father's drinking	=	1
Father's desertion	=	2
Mother's desertion	=	3
Family Quarrels	=	4
Court cases	=	5
Family planning	=	6
Serious physical disability	=	7
Unemployment	=	8
Not recorded	=	9

Welfare Centre ———

Family Number ——

		Col. No. Card*9
31c) If yes, from whom (0):		
Employer = 1		
Merchant = 2		
Money Lender = 3		
Relative = 4		
Friend = 5		
Others = 6		
Not Recorded = 9	c) —	56
d) If yes, Reason for Debt (Two Reasons): (see code, P. 11A)	d) — —	57—58
32 Savings:		
a) Yes—no (0): Yes = 1		
No = 0		
Not Recorded = 9	a) —	59
b) If yes, Amount (00000):	b) — — — — —	60—64
33. Average Amount spent on Daily Diet (000):	— — —	65—67
34. Social Problems of Family (0): (see code, P, 11A)	—	68

END

APPENDIX XV

DATA PREPARATION

In the Kottar data set, the responses to the survey were recorded directly on the questionnaire forms by a team of interviewers drawn from CHDP workers especially trained as interviewers by John Field and David Pyle. The quantity of data is substantial; therefore, it was best to rely on a computer for analysis. Dr. Field and Mr. Pyle arranged the shipment of the questionnaires from the K.S.S.S. to the Massachussetts Institute of Technology in Boston. There, the data were keypunched according to the format indicated on the questionnaire. The data for a single interview filled nine computer cards.

Using a magnetic tape containing the card images of the data, a process was implemented to eliminate as many of the "correctable" errors in the data as possible to avoid later distortions in the analysis.

Errors made by the respondent or interviewer could not actually be corrected; however, it was possible to remove codes which were obviously incorrect and substitute "missing" codes. Errors made in the data processing phases were often truly correctable; however, due to limitations in resources, some errors that might have been corrected through reference to the coded interview forms were corrected by substitution of "missing codes." The effort of returning to the source documents to correct those few errors was deemed to be too great.

The data processing activity is described below.

Step 1: Duplicates And Sequence Errors

The software packages (generalized computer programs for data manipulation and analysis) available at the University of Michigan (whose computer

was used for this analysis) require that identification numbers for each survey respondent be unique. In order to insure this unique identification, we scanned the 39,366 card images manually to locate obvious errors in the identification numbers.

This manual scan was prompted by a chance event -- a listing of the first 90 card images on the tape, made only to verify that the University of Michigan computer could read the tape made in Boston, revealed the existence of one duplicate identification number. In this case, as in all others found by the manual scan, the sequence of the interviews on the tape was a key to determining which identification number was wrong.

After manually scanning the listing and correcting the obvious errors, two FORTRAN programs were written to check for any remaining duplicate identification numbers and, also, to locate any interviews with fewer than nine cards. (Listings of all FORTRAN programs written especially to process the Kottar data are included in a separate volume).[1] No interviews were found with fewer than nine cards. Where duplicate identification numbers were found, cards were checked to determine whether interviews were in fact duplicated or whether identification numbers had been incorrectly entered. Arbitrary decisions were made to change one of each pair of duplicates to guarantee the unique identification of each respondent. Although this does not alter the analysis in any way, it precludes returning to Kottar and matching children's records to the surveys by identification number. The manual scan and the computerized search for duplicates resulted not only in changes of forty identification numbers but in other significant

[1]See Volume 8 of this series: William D. Drake and Roy I. Miller, Volume 8: Internal Reports: Code Books, Growth Standards, Intake Standards and Other Documentation (January 1981).

revisions as well. Village 8, Kotoorconam, was originally included as a control village. Inspection of the data revealed, however, that there were no anthropometric measurements for children from this village because they had not participated in the CHDP. Although investigators had intended to gather anthropometrics in this village, none were recorded. Therefore, the interviews from village 8 were eliminated from the data set. The remaining 4133 interviews were sorted and a "new" working file created for step 2.

Step 2: The Timeseries Data - Weight and Health

Analysis of nutritional status data collected over time for the same set of individuals presents some unusual problems. Generally, one wants to look at the overall status of the community at different points in time. Also, one wants to look at the status of individuals of a given age who have participated in the program for varying lengths of time (for example, one may want to compare 3 year old children who had participated for over 2 years to those three year olds who had participated for less than one year.)

Given the data handling and statistical software available at the University of Michigan, the best approach for accommodating these multiple perspectives is to extract observations for each child, derive selected supplementary variables, and create a single data file, consisting of an individual record corresponding to unique observations. This was done using a FORTRAN program which not only created the supplementary variables (child observation number, length of time in program, weight as a percentage of the India weight-for-age standard used in Kottar, and weight as a percentage of standard of the Harvard standard) but also recorded the entries relating

to the child's health and checked all variables for errors. A sample page of the printout from this program is presented in Figure XV-1. In this, as in subsequent computer generated tables, portions used as examples are highlighted by enclosure in boxes. Error checks consisted of range checks (for example, the code for sex had to be 1 or 2), consistency checks (for example, a child who was sick had to have an entry for disease type) and checks that the weight as a percentage of standard variables were within a reasonable interval from the normal. The printout shows asterisks under erroneous entries; for example, family 00-0047 contained no entry for month of observation and the child weighed 59 kilograms.

The program was run twice. The first time, errors were identified and, wherever possible, corrections made -- often after a glance at the entire survey to locate keying errors. (For example, a quick look at the family 00-0016 showed that the "skip" key on the keypunch split the 10/6 observation into two observation fields creating the appearance of an observation in the 0th month of 1971.) Most of the errors were correctable; in fact, most were the result of apparent keypunch errors. Approximately 25 percent of all interviews contained some error.

After cleaning, only 2 percent of the errors remained. The most troublesome errors were those in which a birth date was obviously incorrect; for example, cases existed where the stated birth date was several months later than the child's first observation. (See family 00-0020 in Figure XV-1). These errors were not correctable, and for approximately 60 children, the time series observations were eliminated from the data set. (In another 40 cases, the birth dates were believed to be wrong but, because they were "possible," they were not eliminated.) The second time the program was run,

FIGURE XV-1: SAMPLE PRINTOUT FROM ERROR CHECK ROUTINE
(Time Series Data, Kottar)

```
WC FAM# S BY+Y TH+Y  YR MO  WT S T1 T2 O# AGE PT PCTI PCTH   FEC
-----------------------------------------------------------------
00 0011 2 10 5 88 8
                     6 06 034 2  2  8  2   8  6  486  405    96
                         *
00 0015 1 05 4 88 8
                     6 02 063 2  9  8 19  21 20  637  530   147
                         *
00 0016 1 08 6 98 8
                     6        9  8  8  2  99 99 9999 9999   167
                        *                     *
                     1 00 440 9  8  8  4  99 00 9999 9999   168
                     *  *                     *
00 0020 1 10 6 88 8
                     6 06 059 2  6  8  1  99  0 9999 9999   209
                                          *
                     6 07 058 3  8  8  2  99  1 9999 9999   210
                                          *
                     6 08 061 3  8  8  3  99  2 9999 9999   211
                                          *
                     6 09 064 3  8  8  4  99  3 9999 9999   212
                                          *
                     6 10 072 3  8  8  5   0  4 2118 2118   213
                         *
                     6 11 074 2  6  8  6   1  5 1898 1721   214
                         *
                     6 12 077 3  8  8  7   2  6 1731 1540   215
                         *
                     7 01 083 3  8  8  8   3  7 1694 1457   216
                         *
                     7 02 086 3  8  8  9   4  8 1608 1366   217
                         *
                     7 03 090 2  6  8 10   5  9 1552 1305   218
                         *
00 0047 1 12 4 98 8
                     5 00 590 9  8  8  6  99 99 9999 9999   598
                         *                     *
00 0051 2 10 3 88 8
                     7 07 132 3  8  8 32  45 33 1025  825   740
                         *
00 0053 2 09 3 88 8
                     5 07 073 3  0  8 20  22 19  730  606   767
                                *
00 0055 2 06 4 01 7
```

a corrected file of observations was created containing 79,687 observations on 4075 children.

Another program was written to create additional variables in this corrected file. Variables added included change in weight since previous observation, change in age since previous observation, change in weight since first observation, change in both the India and Harvard weight/weight(age) variables since previous observation, and the total number of observations for a child.

Step 3: The Cross-sectional Data

The cross-sectional survey data collected from program participants in the Kottar program appeared on the last three cards punched for each interview. A FORTRAN program was written to read these cards and search for range violations and inconsistencies between entries.

A sample page of the output is shown in Figure XV-2. The top two lines of the page serve as an aid in counting the columns. (Note: 10, 15, 20, etc.) The first three entries in each line, which appear on the left of the column counter line, are: card number (7, 8, or 9), village number, and family number. The last entry on each line under the column counter is an exact replica of the card. Again, asterisks are placed under erroneous entries. For example, the asterisks in columns 25 and 26 of record 16 indicate an error. (In this case, column 20 indicated that the child had been given two doses of small pox vaccine but only one date of vaccination is given.)

As before, many of the errors were keypunch errors. A look at records 448 and 499 in Figure XV-2 illustrates how troublesome these can be. By comparing the permissible codes for entries in the last seven columns of a

FIGURE XV-2: SAMPLE PRINTOUT FROM ERROR CHECK ROUTINE

(Cross Sectional Data - Kottar)

```
                **1****1****2****2****3****3****4****4****5****5****6****6****7****7****8
                 0    5    0    5    0    5    0    5    0    5    0    5    0    5    0      REC
7 00 0008              0872053  .0          0   30260360460          320          1110552     16
                                 **
7 00 0010              0571035   2067077   10273026036046          320          1100041     34
                                                        *
9 00 0022              000 01845          01845001440018450   0  0     0400                 117
                                                                 *
7 00 0029              3871027   2067077   10272067077   0          32120302     1020658    160
8 00 0029   090601                                   01010001221023101   012012   102        *  161
                                                                          *
7 00 0034              0671057   2067077   10271067      0          321          1100551    205
                                                                        *
8 00 0040   091103652712                             03030001225423101022012106    9         242
                                                                          *          *
8 00 0041   090002732                                03020011131022101   007010   102  01   251
                                                                          *
7 00 0046              0871054   2067077   0   30260360560          52120707     2100016    277
8 00 0046       06612631651673742                    06050011222222101   005      102        *  278
                                 ****
8 00 0047   1000056416726917 11                       05050001222222101   015010   0          287
             *  *                                                          *
7 00 0050              0771013   010577    102730260360561106       320          1100549    313
                                 *****
8 00 0052   090003692731                             04031001223222101010015025   104        332
                                                                          *
8 00 0056   090503672711                             03030001222222101   015015   0          359
                                                                          *
9 00 0070              000 035000100      04500032400499010045043 8      0904                432
                                                                  *
7 00 0073              0971015   1057      102730260360460          73120503     110004     448
8 00 0073   810000366169 2                           05030102131022100                 *    *
                         *  **                                   **                   0      449
9 00 0077              000 009000037 5    01775013000177510050052 0      0400                477
```

card 7 in record 448, one can determine that the data are shifted one column to the right. Similarly, with the exception of the village and family numbers which are automatically duplicated by the keypunch from the preceding card during data entry, the first 14 columns of card 8 are also shifted one column to the right. The result is a mother born in 1904 rather than 1948 according to the last two columns of card 7, and an illegal occupation code of 81 according to columns 8 and 9 of card 8. (Note, had the last digit of the mother's birth date been anything other than an 8, the character carried over from card 7 to card 8 would have placed a value other than "8" in column 1 of card 8 and the interview would have "failed" the test administered in step 1 to determine whether the nine cards of each interview were in sequence).

There were errors in approximately 40 percent of the interviews. Unfortunately, two types of error were not only uncorrectable but also not subject to elimination using missing codes. In the first type, total income did not equal the sum of its parts. In the second type, the number of birthdates reported for a participant's brothers and sisters did not agree with the number reported as being alive. The latter error renders the calculation of birth order impossible.

Quantitative variables such as income and land owned were <u>not</u> subjected to range checks as we did not know which extreme values were legitimate and which were in error. Only 2 percent of the interviews could not "pass" the error checking procedure after cleaning.

Step 4: The Data Base Management System

After the data were cleaned, they were placed into a data base management system (DBMS) called MICRO. This DBMS facilitates the organization of

the data into subsets for subsequent analysis. The initial structure for the data base grouped all variables on card 7 into a single data set, all those on card 8 into a second data set, all those on card 9 into a third set and, finally, all of the longitudinal observations of weight and health, into a fourth set. (Note: a MICRO data set consists of two components: a dictionary which defines the variables and a data file which contains the actual data. The dictionaries for the four basic data sets are documented in Volume 8 of this series.[2]

In anticipation of step 5, and prior to the entry of data into MICRO, some variables were recoded since, MIDAS, the statistical analysis system, does not allow zero codes for variables that are partitioned into discrete categories. Also, confusion results between blanks and zeros. Blank fields in the data were given either a missing or a not-applicable-code. Special FORTRAN programs were written to recode the records. (Formats for the data cards after recoding are included in Volume 8 of this series.[3]

Step 5: The Statistical Analysis Package

The MICRO system has the capability of passing a data set directly to the MIDAS statistical system; a chunk of data in MICRO is, for all intents and purposes, in MIDAS as well. Thus, the final step was also the simplest.

---

[2]Drake, Miller, op. cit.

[3]Drake, Miller, op. cit.