

Malnutrition among children in the area around Kodaikanal, Tamil Nadu, India.

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1. Background

In the foreword to "The state of the world's children 1998" published by UNICEF, Secretary-General of the United Nations Kofi Annan writes: "Over 200 million children in developing countries under the age of five are malnourished. For them, and for the world at large, this message is especially urgent. Malnutrition contributes to more than half of the nearly 12 million under-five deaths in developing countries each year. Malnourished children often suffer the loss of precious mental capacities. They fall ill more often. If they survive, they may grow up with lasting mental or physical disabilities." The number of children affected by malnutrition is frightening. According to "The state of the world's children 1998", 226 million children are stunted in growth and shorter than they should be for their age. Stunting indicates long-term reduction in dietary intake. 67 million children are estimated to be wasted, which means they are below the weight they should be for their height, also indicating short-term reduction in dietary intake. About 183 million children weigh less than they should for their age. Out of the 11.6 million deaths among children under-five in 1995 in developing countries, it has been estimated that 6.3 million, or 54 %, were associated with malnutrition (WHO Global Database on Child Growth and Malnutrition 1997).

Chronic malnutrition is synonymous with growth failure in children. Measuring the height and weight of the children is the most common way of assessing malnutrition in populations (UNICEF: The state of the worlds children 1998, Panel 2). It is recognized that poor growth in children is not only related to deficiency of protein and energy, but also to inadequate intake of vital minerals (such as iron, zinc and iodine), vitamins (such as vitamin A) and often essential fatty acids as well. While these micronutrients are needed at all ages, the first three years of life are most crucial and vulnerable to the harm of undernutrition (Singh M.

2004). Deficiency of one or more of the different micronutrients has different severe consequences. Iodine deficiency can damage intellectual capacity (Dearth-Wesley T, Makhmudov A, Pfeiffer CM, Caldwell K. 2004), while anaemia is an important factor in the pregnancy and childbirth complications that kill 585 000 women annually (UNICEF: The state of the worlds children 1998, The silent emergency). Folate deficiency in expectant mothers can cause birth defects in infants, such as spina bifida and anencephaly (Oakley GP Jr, Bell KN, Weber MB. 2004). Vitamin D deficiency can lead to poor bone formation, including rickets and osteomalacia (Takeuchi Y. 2003). Vitamin A deficiency, which affects about 100 million young children worldwide, causes not only blindness, but also impairs the immune system (Ag Bendeck M, Malvy DJ, Chauliac M. 1997). Iron deficiency affects approximately 20 % of the world population, and the symptoms include impaired physical and intellectual performance (Schumann K, Elsenhans B, Maurer A. 1998). In infancy and early childhood, iron deficiency anaemia can delay psychomotor development and impair cognitive development, lowering a child's IQ by about 9 points (UNICEF: The state of the worlds children 1998, The silent emergency).

Some severely malnourished children develop clinical signs that are easily observed; severe wasting (marasmus), or the syndrome known as kwashiorkor with skin and hair changes and swelling of arms and legs. Infections are frequently a consequence of malnutrition, and malnutrition is also commonly the result of infections (Cartmell E, Natalal H, Francois I, Ferreira MH, Grahnquist L 2005). Malnourished children tend to have more severe diarrhoeal episodes, in terms of duration, risk of dehydration or hospital admission and associated growth faltering (Tomkins A and Watson F 1989). The risk of pneumonia is also increased in these children (Victora CG, Fuchs SC, Flores A, Fonseca W, Kirkwood BR 1994). Malnourished children are much more likely to die of common childhood diseases

than children who are adequately nourished (Murray CJ, Lopez AD. 1997). The same study also showed that malnutrition is the risk factor responsible for the greatest loss of DALYs (disability-adjusted life years) (15.9%), followed by poor water supply, sanitation, and personal hygiene (6.8%).

In young children, malnutrition dulls motivation and curiosity and reduces play and exploratory activities. This can lead to impairment of mental and cognitive development (Yaqoob M, Bashir A, Zaman S, Ferngren H, Von Döbeln U, Gustavsen KH 2004).

Research also indicates a link between malnutrition in early life, including the period of fetal growth, and the development of chronic conditions like coronary heart disease, diabetes and high blood pressure later in life (UNICEF: The state of the world's children 1998, The silent emergency).

One of the main consequences of small adult size resulting from childhood stunting is reduced work capacity, which in turn has an impact on economic productivity (Spurr GB, Barac-Nieto M, Maksrud MG 1977).

Maternal size is associated with specific reproductive outcomes. Short women, for example, are at greater risk for obstetric complications because of smaller pelvic size (WHO Technical Report Series No.854 1995). There is also a strong association between maternal height and birth weight which is independent of maternal body mass (Kramer MS 1987). There is thus an intergenerational effect (Klebanoff MA, Yip R. 1987), since low-birth-weight-babies are themselves likely to have anthropometric deficits at later ages (Binkin NJ, Yip R, Fleshood L, Trowbridge FL 1988).

The purpose behind this study was to map the level of malnutrition among children in the villages in the area around Kodaikanal, India, and to detect factors contributing to malnutrition.

2. Methodology

2.1 Study area

Tamil Nadu is the southernmost state of India, with a population of 62.1 million. The capital and largest city is Chennai (earlier named Madras), and the main language is Tamil. Table 1 contains a summary of facts about India and Tamil Nadu as presented in the National Family Health Survey (The International Institute for Population Sciences, 1998-99).

Table 1. Information based on NFHS-2 Fact sheet.

	India	Tamil Nadu
Population, 1 July 2000 (in millions)	1002.1	61.9
Percent of females illiterate (age 6+)	48.6	41.7
Percent of households with drinking water piped or from hand pump	77.9	85.0
Percent of households with no toilet/latrine facility	64.0	65.9
Total fertility rate	2.85	2.19
Percent of currently married women using any contraceptive method	48.2	52.1
Infant mortality rate (per 1000 live births)	67.6	48.2
Under-five mortality rate (per 1000 live births)	94.9	63.3
Percent of children age 12-23 months who have received all vaccinations	42.0	88.8
Percent of children age 6-35 months with any anaemia	74.3	69.0
Percent of children under age three years underweight (weight-for-age)	47.0	36.7
Percent of children under age three years stunted (height-for-age)	45.5	29.4

Percent of children under age three years wasted (weight-for height)	15.5	19.9
Percent of women with BMI below 18,5 kg/m ²	35.8	29.0
Percent of women age 15-49 with any anaemia	51.8	56.5

Kodaikanal is a hill station in the Western Ghats in Tamil Nadu, at an altitude of 2100 metres. American missionaries established a school for European children there in the mid-1840s. Today the population is approximately 40 000 people and the main sources of income are tourism and farming. Approximately 50 % of the people living there are Christians, while 30% are Hindus and 20% are Muslims.

The area around Kodaikanal is mountainous and covered with a tropical forest. The indigenous people of the region typically reside in the forest. According to Dr. Lawrence there are about 45 000 inhabitants who live in 33 small, remote villages (that have been identified so far). They are called the Adivasi and make up the lowest caste of society. For centuries they have been harassed and abused by people from higher castes, and they have always been underpaid. For this reason they have found refuge in the forest. There they are deprived of basic amenities like food, healthcare and education. Many programs of the government do not enter into these villages, which are far away from the roads. Ignorance, poverty and illiteracy of the tribal people add to this problem.

2.2 Data collection procedure

The method used in this survey was a combination of personal interviews, observation and questionnaires, which included measuring height and weight (Appendix 2). Dr. Bevin Lawrence has been working in this mountainous area for approximately ten years. He was

my local informant, and he organized the data collection, which took place from mid-November to mid-December 2003. A team consisting of four people carried out the field work. The children were easily gathered at the different locations, and their height and weight were measured. Dr. Lawrence asked the questions from the questionnaire, and translated the answers into English. Dr. Lawrence checked the colour of the eyelids of the children, to tell who were anaemic. By examining the skin and hair of the children, he told who were marasmic. Vit.B¹² and Paracetamol were administered to those in need.

After finishing the measuring I was shown throughout the village/orphanage. I tried to get an impression of the social conditions, especially the sanitary conditions and water supplies. Through an interpreter I could interview a key informant (an elder/leader) at each location, and gather information regarding population, diet, literacy rate, cultural characteristics, superstitious beliefs, sources of income, access to health aid etc.

2.3 Study sample

Five different villages were included in the study as well as two orphanages in Koidakanal:

Kadamanrevu and Koimbakadu (village 1 and 2):

Thirty-nine children from Kadamanrevu and fourteen from Koimbakadu were included in the study. These two villages are situated 2-3 kilometres from each other. The inhabitants have much interaction and are very much related. The economical, social and cultural conditions in the villages are similar. The population in the villages is approximately 500 in each village. They are all Adivasis and previously lived deeper in the forest. The government has built new houses made of concrete for them alongside the road and they have lived there

since the early 1990's. Photo 5-8 in Appendix 1 is from Kadamarevu, and photo 9-10 is from Koimbakadu.

Kumbur (village 3):

Forty-six children from Kumbur were included in the study. This village can be reached by car, and lies approximately 7 kilometres from the main road. The population is approximately 500, and the people are from two castes called Chettiyar and Asari (middle class). They have a primary school for the children. We visited this school, and checked the nutritional status of the pupils there. Photo 11-12 in Appendix 1 is from Kumbur.

Moongilpallam (village 4):

Twenty-three children from Moongilpallam were included in the study. There are 24 families living there, and the population is about 200. Out of the four villages in this study, Moongilpallam lies deepest into the jungle, and furthest away from civilization. You have to walk 3-4 hours from the main road to reach Moongilpallam. The people there are Muduvans (from the Adivasi-caste), and according to Dr. Lawrence they are hostile to outsiders. The Muduvans mainly live in small huts made of bamboo or caves. It was not until 1996 that the government accepted that Moongilpallam and some other villages existed, and only then were these people registered as citizens of India. Dr. Lawrence had to take photos of the heads of each family and show the government, before they were registered. Earlier they did not have means of going to school or support in any way. But as a result of their registration, they now get support in different ways. Houses with thin sheets for roofs have been built in some villages, and they have received a small number of solar lamps. Through the government they now also receive a portion of rice each day. Photo 13-17 in Appendix 1 is from Moongilpallam.

TEAM Vision Hostel (orphanage 1):

Twenty-nine children from this orphanage were included in the study. This hostel for children in Kodaikanal was established in 2000, for the purpose of giving indigenous children an opportunity to attend school. The children stay there during the time of the year they attend school, but visit their home villages during holiday breaks. Presently 40 children live there, together with one staff. Photo 1-4 in Appendix 1 is from the TEAM Vision Hostel.

The orphanage run by CMS, Christian Missionary Society (orphanage 2):

Thirty-eight children from this orphanage were included in the study. This orphanage in Koidakanal was established in 1975. Now 56 children live there, together with five adults working there.

2.4 Type of data collected, validity and reliability

The quantitative data in the questionnaire consisted of sex, age, weight, height, status of parents (still living or deceased), number of siblings alive, number of siblings deceased, birth order of the child, delivery age of the mother, whether the parents had regular income, meals per day, vaccines received (yes/no) and years previously lived in home (only at the orphanages). It soon proved difficult to get accurate information concerning several of the variables. The ages of the children were not known, but Dr. Lawrence gave an estimated age of each child. Neither was the delivery age of the mother known. The validity of the variable status of parents proved to be very poor, because only three of the children in the villages admitted that one or both parents were dead. No one would admit that they had any dead siblings, so this variable was of no value. In every village the income was dependent on the season, and therefore it was impossible to separate between those with regular income and

those without. It was difficult to get an accurate estimation of meals per day, since this was also dependent on the season.

By interviewing a key informant at each location I got qualitative information regarding sanitary conditions, water supplies, population, diet, literacy rate, cultural characteristics, superstitious beliefs, sources of income, access to health aid etc. Dr. Lawrence added to and confirmed this information.

2.5 Inclusion criterias

Table 2 shows the age and height limitations regarding the different anthropometric indices, which is recommended by WHO, and followed in this present study.

Table 2. Age and height limitations for the CDC/WHO international growth reference curves.^a Source: Gorstein J, Sullivan K, Yip R, de Onis M, Trowbridge F, Fajans P, Clugston G 1994.

<i>Index</i>	<i>Sex</i>	<i>Minimum age (years)</i>	<i>Maximum age (years)</i>	<i>Minimum height (cm)</i>	<i>Maximum height (cm)</i>
Weight-for-height	Males	Birth	11.49	49	145
	Females	Birth	9.99	49	137
Weight-for-age	Both	Birth	17.99	None	None
Height-for-age	Both	Birth	17.99	None	None

^aThere are no weight limitations

For the calculation of WHZ, only boys under 11.5 years and below 145 cm, and girls under 10 years and below 137 cm should be included. For the present study this meant that the relevant sample population decreased from 189 to 152.

The commonly used cutoff value for malnutrition is Z-score below -2 , and this is followed in the present study.

2.6 Statistics

Malnutrition, indicated as Z-score of value -2 or less, was estimated for the values of weight for height, weight for age and height for age. Weight for height Z-score (WHZ), weight for age Z-score (WAZ) and height for age Z-score (HAZ) were calculated using the EpiInfo 6, after first using the SPSS 11.0 to calculate the values of weight for height, weight for age and height for age. The chi-square test was used to assess distribution of children below the cut off point for malnutrition (Z-score < -2) for selected categorical variables (significant level $P < 0.05$). The logistic regression technique was used for the estimation of the odds of being wasted. This statistic method permits control of the other potential confounders. The dependent variable was dichotomised into children whose Z-scores were below -2 (coded 1) and those with Z-scores of -2 or higher (coded 0). The categorical variables entered into the regression equation are sets of dummy variables. Thus, the results obtained were compared to the reference category. The predictor variables used in the logistic regression model are sex, age, location, anaemia, siblings alive and birth order. The reference categories for the different variables mentioned above are: male, 1-4 years of age, orphanage 1, not anaemic, 0-2 siblings alive and birth order 0-2. All the different variables were analysed separately, using multiple linear regression to identify groups having higher or lower risk of being wasted.

In the last step multiple linear regression analysis with forward selection was used to identify predictors for being wasted ($WHZ \leq -2$).

3. Results

3.1 Quantitative results

Table 3 shows the nutritional status of the children present in the study in terms of WHZ. Comparing Table 3 and Table 8 gives the relative prevalence of malnutrition in the study group.

Table 3. Percentage of children with WHZ-scores below -2SD

VARIABLE	≤ -2 Z (n=31)	P-value (chi-square)
SEX		0.84
-Male (n=76)	21.1 %	
-Female (n=76)	19.7 %	
AGE		0.12
-1-4 years (n=35)	31.4 %	
-5-9 years (n=83)	19.3 %	
-10-12 years(n=34)	11.8 %	
LOCATION		<0.001
-Orphanage 1 (n=19)	26.3 %	
-Orphanage 2 (n=27)	0 %	
-Village 1 (n=37)	24.3 %	
-Village 2 (n=13)	30.8 %	
-Village 3 (n=37)	5.4 %	
-Village 4 (n=19)	57.9 %	
ANEMIA		0.50
-No (n=101)	18.8 %	
-Yes (n=51)	23.5 %	
PARENTS ALIVE ¹		0.02
-None (n=0)	0 %	
-Mother alive (n=1)	0 %	
-Father alive (n=2)	0 %	
-Both alive (n=103)	25.2 %	
SIBLINGS ALIVE ¹		0.03
-0-2 (n=54)	16.7 %	
-3-5 (n=44)	27.3 %	
-6-10 (n=8)	62.5 %	
BIRTH ORDER ¹		0.02

-0-2 (n=55)	23.6 %	
-3-5 (n=44)	18.2 %	
-6-10 (n=7)	71.4 %	
YEARS IN ORPHANAGE ²		0.41
-0-2 (n=16)	18.8 %	
-2.5-4 (n=28)	7.1 %	
-4.5-7 (n=2)	0 %	
TOTAL (n=152)	20.4 %	

¹Only children in villages are included

²Only children in orphanages are included

It is observed that the relative prevalence of wasting (acute malnourishment) was generally very high in the study group, 20.4 %. Although the female children had lower prevalence of malnutrition, the prevalence was almost the same for male (21.1 %) and female (19.7 %) children. The younger children were more wasted than the elder ones, but this result was not significant (P-value 0.12). There was a wide difference in the prevalence of wasting in the different locations, ranging from 0 % up to 57.9 %, and this difference was significant (P-value < 0.001). Those who were registered as anaemic had a higher prevalence of wasting than those who were not, but not significantly higher (P-value 0.50). Those who had their parents alive had a significantly higher prevalence, than those who did not (P-value 0.02). Children with few siblings had a significantly lower prevalence, than those with many siblings (P-value 0.03). Children whose birth order was 6-10 had a significantly higher prevalence, than those whose birth order was 0-2 and 3-5 (P-value 0.02). The prevalence was higher among the children who had been 0-2 years in the orphanages, than among children who had been there longer, but this was not a significant difference (P-value 0.41).

Table 4 shows the results of the logistic regression for weight-for-height indicating the odds of being wasted in various categories of the study sample.

Table 4. Odds of being below -2Z for weight-for-height: 95% confidence intervals. ^a

VARIABLE	≤ -2Z OR (95% CI)
SEX	
-Male (n=76)	1.00
-Female (n=76)	0.52 (0.20-1.35)
AGE	
-1-4 years (n=35)	1.00
-5-9 years (n=83)	0.73 (0.22-2.42)
-10-12 years (n=34)	0.54 (0.09-3.22)
LOCATION	
-Orphanage 1 (n=19)	1.00
-Village 1 (n=37)	2.53 (0.53-12.08)
-Village 2 (n=13)	3.56 (0.54-23.22)
-Village 3 (n=37)	0.56 (0.09-3.40)
-Village 4 (n=19)	12.01 (1.65-87.36)
ANEMIA	
-No (n=101)	1.00
-Yes (n=51)	0.68 (0.22-2.16)
SIBLINGS ALIVE	
-0-2 (n=54)	1.00
-3-5 (n=44)	1.99 (0.55-7.30)
-6-10 (n=8)	2.84 (0.45-18.12)
BIRTH ORDER	
-1-2 (n=55)	1.00
-3-5 (n=44)	0.41 (0.12-1.35)

^aAll variables were mutually adjusted for each other.

Girls had a nearly 50 % lower risk for being wasted, although this difference was not statistically significant. The odds of being wasted decreased as the children grew older. The only group in the study population with a statistically significant increased risk of being wasted was the children from village 4, Moongilpallam. The children in two of the other villages, Kadamanrevu and Koimbakadu, also had higher odds of being wasted than the children from TEAM Vision Hostel. The results showed that anaemic children had lower odds of being wasted than the non-anaemic. Children with 3-5 siblings alive had higher odds of being wasted than children with 0-2 siblings alive, but lower odds than children with 6-10 siblings alive. These results are not statistically significant. The categories of birth order did

not turn out to be significant. The results show that children of first- or second-order births had lower odds of being wasted than third- to fifth order births.

Table 5. Multiple linear regression analysis with forward selection identifying predictors for being wasted (Z-score ≤ -2)^a

Variable	$\leq -2Z$ OR (95% CI)
Location	
-Orphanage 1 (n=19)	1.00
-Village 1 (n=37)	2.86 (0.71-11.51)
-Village 2 (n=13)	4.44 (0.71-27.66)
-Village 3 (n=37)	0.48 (0.09-2.71)
-Village 4 (n=19)	13.90 (3.13-61.71)

^aAdjusted for age and gender

The odds of being wasted were 13.90 times higher in village 4, Moongilpallam, than in the TEAM Vision Hostel.

Table 6. Quantitative results from Moongilpallam compared to the whole study sample.

	<i>Study sample</i>	<i>Moongilpallam</i>
Sex	76 girls and 76 boys	13 girls and 6 boys
Age	6.8 years	5.5 years
Siblings alive	2.4	4.0

3.2 Qualitative results

Kadamanrevu and Koimbakadu (village 1 and 2):

In these two nearby villages all the inhabitants were illiterate, and there was no opportunity for schooling. Any income is a result of farming, but only a few raised their own crop. Therefore, most of the inhabitants worked on larger farms in the area. The income was seasonal, with less income during the rainy season.

They got their water from a river nearby, but in Kadamanrevu they also had a pipe going to water-sources deep under the ground. They went into the forest for defecation. There was a visit from a paramedical unit once every third month. If a person was seriously ill, and there was money available, he would be taken to the hospital in Palani which is 25 kilometres away. Some of the children in these villages had been vaccinated.

Their food consisted of rice, potatoes and vegetables. They had meat 1-2 times a year.

Normally they ate two meals a day, but this varied with income.

Out of 54 children, 22 were anaemic and 5 were marasmic.

Kumbur (village 3):

The teacher at the primary school in this village estimated that 20% of the adults were literate, the majority of those being males. Most of the inhabitants were farmers and earned income from the crops. They grew potatoes, carrots, cabbage, garlic etc. The income was dependent on the season, with the rainy season bringing less income. Some of the inhabitants worked in the city (Kodaikanal) and had regular income.

The food consisted of rice, potatoes, vegetables and weekly meat. They normally partook of three meals a day.

Their water is supplied by a piping system that runs to a water-source deep under the ground, and the quality of the water was estimated to be better than in the other villages. Despite their higher literacy rate, there was a complete lack of latrine facilities. The houses had thin sheets for roof, and generally had a higher standard than in the other three villages visited.

There was a paramedical visit to the village once every month, and the villagers also had the opportunity to visit a clinic in Mannumanur, 7 kilometres away.

Twenty-two of the 44 children were mildly or more severely anaemic, and a few were found to be marasmic.

Moongilpallam (village 4):

According to Dr. Lawrence all the inhabitants in this village were illiterate. The hygiene there had improved after TEAM Vision started teaching about proper hygiene, but was still poor. It was not allowed for anyone to marry outside the village, so everybody was related to each other, and this added to the challenge of poor health.

The opportunities for income were few and limited. Traditionally they did not live by farming, but recently this has begun to change. The land around the village was barren, but there was an area where they had started to grow garlic. Lemon grass grew well despite the barren ground, and out of this they made lemon grass oil, which they sold in a town nine hours walking distance from Moongilpallam. They also bought calves, and sold them when they were cows, and made some profit. Dr. Bevin Lawrence had estimated the annual income for a family to be 2000 Rupees (400 NKR/60 USD), and the families often included 7-8 children. During the rainy season there was less opportunity to make money, because they were not able to leave their houses. During this season they ate food that they had stored, which often was not adequate to meet their needs.

From their income they bought rice. The food otherwise consisted of wild roots, maize, fruits from wild plants and honey. Meat was extremely rare in their diet, maybe only once a year. They ate one meal per day. When the children from Moongilpallam first arrived at the TEAM Vision hostel in Kodaikanal, they always vomited after the second meal for the first few months according to Dr. Lawrence.

There was a pipe from the river that brought water to the village. They had a specific area outside the village which they used for defecation.

There were no medical facilities available to them, except the help Dr. Lawrence offered them. It was too far and too expensive to attend any hospital. Dr. Lawrence came there once in a month to treat them for free, but during the rainy season (June-July and Oct.-Nov) he was unable to come at all. No one had been vaccinated. Out of the 23 children we saw, 15 were anemic, 5 were marasmic, and many were suffering from respiratory infections.

Superstitious beliefs were common in this and other villages. The common belief was that diseases are manifestations of punishment inflicted by God. Therefore, they never visited doctors until Dr. Lawrence first arrived in 1995. Until then, they only took native medicines, for better or for worse. If an illness took on a serious turn, a witch doctor from the community was summoned for assessment and further treatment. If the witch doctor's verdict was that the patient would die, food and medicines would be withdrawn and the patient was kept in a small hut outside the village, until he or she would starve to death. This superstition is slowly changing by the effort of Dr. Lawrence and his organization, TEAM Vision, and the people now agreed to give food to these victims.

TEAM Vision Hostel (orphanage 1):

The children at this hostel received three meals per day, consisting of rice, potatoes, vegetables, fruit and meat on a weekly basis. They lived in dormitories, separated for boys and girls. They had tap water and the kitchen seemed to be hygienic. The toilets were clean. Once every year they received a medical check-up, and Dr. Lawrence was available if necessary.

Out of the 29 children we saw, 15 had been affected by chickenpox, 6 had respiratory infections, 2 were anaemic due to worm infestation. All the children received treatment for worms every year.

The orphanage run by CMS, Christian Missionary Society (orphanage 2):

The children received three meals per day, consisting of rice, potatoes, vegetables, fruit and meat on a weekly basis. They lived in dormitories, separated for boys and girls. They had tap water and the kitchen seemed to be hygienic. The toilets were clean. Once every year they received a medical check-up, and Dr. Lawrence was available if necessary.

Out of the 39 children we saw, 21 had been affected by chickenpox recently, 10 had respiratory infections, 3 were anaemic and everybody had received treatment for worms.

4. Discussion

4.1 Main findings

The main finding based on the quantitative part of the results was the significant high odds of being wasted in Moongilpallam. The odds of being wasted were 13.9 times higher there than in the TEAM Vision Hostel. It is observed that girls had a nearly 50 % lower risk for being wasted than boys, but this difference was not statistically significant. The odds of being wasted decreased as the children grew older. Children with 3-5 siblings alive had higher odds of being wasted than children with 0-2 siblings alive, but lower odds than children with 6-10 siblings alive. The results show that children of first- or second-order births had lower odds of being wasted than third- to fifth order births.

The main findings based on the qualitative part of the results were some of the contributing factors to the high prevalence of wasting in Moongilpallam, which included: low income, little access to food, 100% illiteracy rate and poor medical facilities and sanitary conditions.

The discussion section has been divided into a method and a result part.

4.2 Methodological issues

4.2.1 Sample

Four villages and two orphanages were selected to be included in this study. The orphanages were included for the purpose of being a comparison to the villages. All sites were chosen by Dr. Lawrence because of the good relationship he had with the leaders. The 152 children in this study were selected from an area with 45 000 inhabitants and 33 villages. It can be questioned whether this study gives a valid representation of the whole area. Dr. Lawrence and his organization TEAM Vision had chosen to work in three villages in the area, Moongilpallam, Kadamanrevu and Koimbakadu. Therefore these villages were probably among the least developed and with the highest malnutrition rate.

The children at the TEAM Vision Hostel came from these three villages. They had been at the hostel for a varying number of years, and there they had received three nutritious meals a day. Since they came from these villages, they were an interesting comparison to the children living in these villages.

4.2.2 Research instruments and data collection

WHO recommends the use of the three anthropometric indices; weight-for-height, height-for-age and weight-for-age in assessing the level of malnutrition in a population. Using these indices in a study requires relatively little time and finances. But it can be questioned whether the international growth reference curves are valid in all ethnical groups. The quantitative data collection consisted of measuring height and weight of the children at the location, assessing whether they were anaemic or marasmic and interviewing them or their mother/father. The interview was brief due to lack of time. The interviewer could not speak or understand Tamil, and the villagers did not speak English. Thus, an interpreter was crucial during the data collection. In the villages the interpretation was done by Dr. Lawrence, while

different people helped out at the two orphanages. Dr. Lawrence was familiar with the inhabitants in the villages and served as a valuable link between the interviewer from abroad and the villagers. On the other hand, the need for an interpreter can also be seen as a barrier to contact between the interviewer and the respondents and thereby may have had an impact on the information collected. The interpreter might have had a desire to give a good impression of the village/orphanage. But he could also have wanted to make the village/orphanage look as poor as possible. The impression I got of the condition in the villages/orphanages, therefore might be biased by the interpreter.

Different people measured height and weight at the different locations. This might have introduced a bias into the data collection. Dr. Lawrence checked the colour of the eyelids of the children, to tell who were anaemic. This was done briefly. The validity of these results would have been higher if we had measured the hemoglobin-level in the blood of the children, but that would have required more time and more equipment. The ages of the children were not known, but Dr. Lawrence gave an estimated age of each child. This introduced a major bias in the study, as age is such an important variable in estimating the nutritional level in a population. In many developing countries the age of a person is not known exactly as in the western world (Denic S, Khatib F, Saadi H. 2004). This introduces a bias in using two of the three anthropometric indices recommended by WHO (weight-for-age and height-for-age). It is in these developing countries that malnutrition is causing major health problems. Table 7 shows the usefulness of the anthropometric indices in different areas and situations. Only one of the three anthropometric indices proved to be appropriate for this study, and that was weight-for-height.

The qualitative data collection consisted of an observational tour through the orphanage/village and an interview with a leader/elder. The person who guided me around at each location, and whom I interviewed, might have had a desire to give a good impression of the village/orphanage. But they could also have wanted to make the village/orphanage look as poor as possible. The impression I got of the condition in the villages/orphanages, therefore might be biased by the guide/informant.

4.2.3 Data processing

The data on weight, height and age of children are used to compute three summary indices of nutritional status in the study population. To assess the nutritional status of individual children, the World Health Organization recommends the use of Z-score indicators. The Z-score indicators of weight-for-age (WAZ), height-for-age (HAZ) and weight-for-height (WHZ) are generally used for evaluating the nutritional status of children. EpiInfo 6 transforms the international growth reference curves into a Z-score representation (WHO, 2001). These growth reference curves have been used worldwide since 1978 to assess the nutritional status of children in cross-sectional surveys (Chauliac M. 1986). It can be questioned whether these reference curves are valid in all societies and cultures. In the preface to the "WHO Global Database on Child Growth and Malnutrition", John C. Waterlow writes: "It is now widely, if not universally, accepted that children the world over have much the same growth potential, at least to seven years of age. Environmental factors, including infectious diseases, inadequate and unsafe diet, and all the handicaps of poverty appear to be far more important than genetic predisposition in producing deviations from the reference". WHZ and HAZ are the most commonly used indices for determining nutritional status (Rajaram S, Sunil TS, Zottarelli LK 2003). The former is considered an indicator of wasting (thinness indicating acute malnourishment) and the latter is considered an indicator

of stunting (shortness indicating chronic malnourishment). The third index, WAZ, is primarily a composite of WHZ and HAZ and is considered to represent acute and chronic malnourishment. These indices present the long-term and short-term prevalence of malnutrition in children.

Table 7. Summary of information on anthropometric indices. Source: Gorstein J, Sullivan K, Yip R, de Onis M, Trowbridge F, Fajans P, Clugston G 1994.

	<i>Weight-for-height</i>	<i>Height-for-age</i>	<i>Weight-for-age</i>
Usefulness in populations where age is unknown or inaccurate	1	4	4
Usefulness in identifying wasted children ¹	1	4	3
Sensitivity to weight change over a short time period	1	4	2
Usefulness in identifying stunted children	4	1	2

1=excellent; 2=good; 3=moderate; 4=poor

¹Depends to some extent on the prevalence of wasting and stunting in the population.

Weight-for-height is useful in assessing wasting, and is essential in populations where age generally is not known. But there are limitations when it comes to assessing stunting, as an accurate age is essential to assess stunting. Height-for-age reveals stunting which indicates chronic malnutrition, and would have been very useful to measure in this study group, but due to lack of accurate age the validity of these results would have been low.

4.3 Results discussion

This part has been divided into two sections. The first section discusses the findings in this present study. The second section discusses the different factors leading to malnutrition, based on a conceptual framework presented by UNICEF.

4.3.1 Causes of malnutrition found in this study

The relative prevalence of Z-scores less than -2 for any population is given in table 8.

Table 8. Prevalence of low anthropometric values (Z-score < -2) in other surveys for children under 5 years of age. Source: World Health Organization (1995)

<i>Index</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Very high</i>
WHZ	<5.0%	5.0-9.9%	10.0-14.9%	$\geq 15.0\%$
HAZ	<20.0%	20.0-29.9%	30.0-39.9%	$\geq 40.0\%$
WAZ	<10.0%	10.0-19.9%	20.0-29.9%	$\geq 30.0\%$

In this present study the total prevalence of wasting in the villages around Kodaikanal was found to be 25.0 %. According to table 8, this prevalence is very high. But the prevalence in the villages is ranging from 5.4 % in Kumbur to 57.9 % in Moongilpallam. The physical distance between these two villages was only three hours of walking, but the distance in nutritional status was much greater. What are the contributing factors to this great difference? The inhabitants in Kumbur were from the middle class, and on the fertile ground around their village they grew potatoes, carrots, cabbage, garlic etc. They had their own primary school, and had access to medical help in Mannamanur, 7 km away. The quality of the water was estimated to be better in Kumbur, than in Moongilpallam and the other villages. The

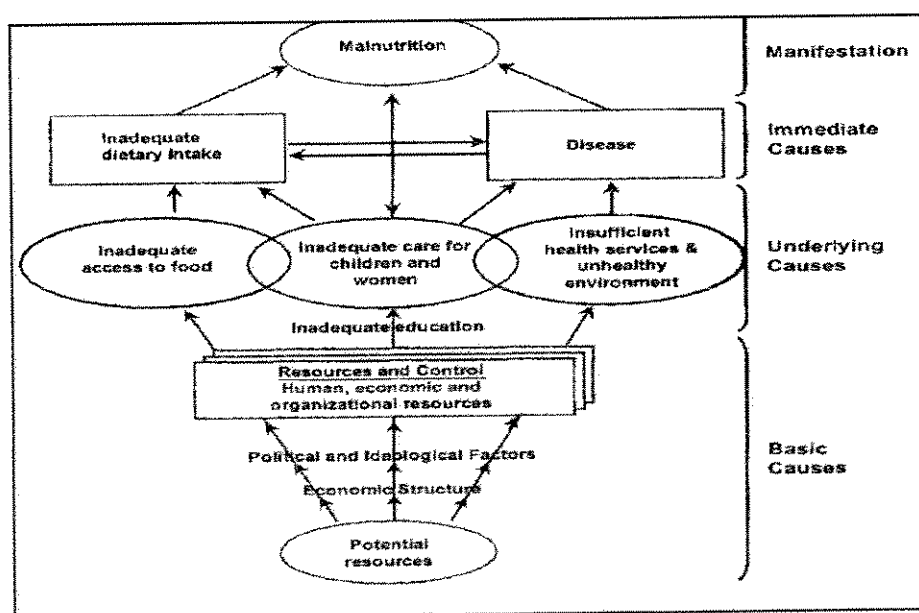
inhabitants in Moongilpallam were from the lowest caste, Adivasi. Traditionally they had not been farmers, and had few opportunities for income. The ground around their village, which was in the middle of the forest, was barren. Though there was an area where they had started to grow garlic. Lemon grass grew well despite the barren ground, and out of this they made lemon grass oil, which they sold in a town nine hours walking distance from Moongilpallam. They bought calves, and sold them when they were cows, and made some profit. But their opportunities for income were limited. The literacy rate in the village was 0 %, as they had never had any opportunity to attend school (with exception for the last three years when Dr. Lawrence had helped them through the TEAM Vision Hostel). No medical facilities were available to them, except the monthly visit from Dr. Lawrence. This was primarily due to lack of finances, but also because of the physical and social isolation they lived under. For centuries they had been harassed and abused by higher castes, and finally they moved into the forest to escape this. They were hostile to other people, and did not interact much with the world outside before Dr. Lawrence first visited in 1995.

The quantitative results also show some interesting differences between the children from Moongilpallam and from Kumbur, which can help explain the difference in nutritional status. In Kumbur the mean for siblings alive was 2.2, while in Moongilpallam the mean was 4.0. Table 4 confirms that children with more siblings alive have higher odds of being wasted than children with fewer siblings alive. The mean age of the children measured in Kumbur was 7.9 years, while in Moongilpallam the mean age was 5.5 years (as most of the older children stayed in the TEAM Vision Hostel). Table 4 confirms that older children had lower odds of being wasted than younger children.

4.3.2 Causes of malnutrition – a theoretical framework

At its most basic level, malnutrition is a consequence of infection and inadequate dietary intake. But many more elements – social, political, economic, cultural – are involved beyond the physiological. Figure 1 is a conceptual framework developed by UNICEF for analysing causes of malnutrition or nutritional insecurity among young children in developing countries (UNICEF 1990; Jonsson U and Toole D 1991). The causes of malnutrition among young children are complex. Children's nutritional vulnerability is, according to the causal framework, related to both underlying and basic social and environmental circumstances. Changes in a child's social and environmental surrounding may affect the child's chance of having his or her nutritional needs met. Since early 1990, the model has been the basis for UNICEF nutrition programmes. It has been an analytical as well as an implementing tool in these programmes (UNICEF, 1998).

Figure 1. A conceptual framework developed by UNICEF for analysing causes of malnutrition or nutritional insecurity among young children in developing countries (UNICEF 1990; Jonsson and Toole, 1991).



The immediate causes are inadequate dietary intake and diseases. The interplay between these tends to create a vicious circle: A malnourished child, whose resistance to illness is compromised, falls ill, and malnourishment worsens. Malnutrition lowers the body's ability to resist infection by undermining the functioning of the main immune-response mechanisms. This leads to longer, more severe and more frequent episodes of illness. Infection on the other hand causes loss of appetite, malabsorption and metabolic and behavioural changes. This increases the body's requirements for nutrients.

The conceptual framework suggests three essential categories of causes underlying malnutrition, namely food insecurity, inadequate caring capacity, and problems with access to health services combined with an unhealthy environment.

In "The State of the world's children 1998" food security is defined as: "sustainable access to safe food of sufficient quality and quantity – including energy, protein and micronutrients – to ensure adequate intake and a healthy life for all members of the family". Food security depends on access to food, and not food availability. Food may be available at the local market, but poor families may not afford it, and these are not food secure. Food security may vary with the season, as the agricultural production is varying. So while poor families may have adequate access to food for one month, what is essential is access that is consistent and sustainable.

Access to preventive and curative health services that are affordable and of good quality is essential for good health. The health center should be in reasonable distance to the home. According to the United Nations Development Program (UNDP), access varies widely, but in as many as 35 of the poorest countries 30 to 50 per cent of the population may have no

access to health services at all. Environmental health has significant implications for the spread of infectious diseases. Included in this term are safe water supply, proper sanitation and unhygienic conditions in and around homes. Most childhood diarrhea is caused by one or more of these factors. According to Human Development Report 1997, UNDP, more than 1.1 billion people lack access to safe water. This is a major obstacle that has to be removed in order to decrease the number of malnourished children.

Protecting the child's health includes assuring that the child receives essential health care at the right time. Immunization, for instance, have to be carried out according to a specific schedule. Therapeutic treatment for a malnourished child in the hospital is far more expensive than preventive care. According to a US Department of Agriculture study from 1990, nutrition investments for pregnant women were very cost-effective: Every \$1 spent on prenatal nutrition care yielded an average savings of about \$3 in reduced medical costs for the children during the first two months after birth.

The third category is inadequate caring practices. "Experience has taught that even when there is adequate food in the house and a family lives in a safe and healthful environment and has access to health services, children can still become malnourished." (Unicef: The state of the world's children 1998, The silent emergency). Care manifests in the different ways a child is fed, nurtured, taught and guided. Critical caring behaviours are feeding, protecting children's health, support and cognitive stimulation, care and support for mothers. Essential to good feeding-practice is knowledge about the importance of breastfeeding and when and how to introduce complementary food. The child should have exclusive breastfeeding for about six months, and then continual breastfeeding with the addition of safe, high-quality complementary food into the second year of life (Quinn PJ, O'Callaghan M, Williams GM, Najman JM, Andersen MJ, Bor W. 2001). The storage and preparation of the food has to be

hygienic. In some cultures there are different misconceptions, which affect the feeding-practice. For instance food and liquids are withheld during episodes of diarrhea (Unicef: The state of the world's children 1998, The silent emergency). Other behaviours that affect nutrition include whether children are fed first or last among family members, and whether boys are fed preferentially over girls.

For optimal development, children require mental support and cognitive stimulation. There is a connection between malnourished children and stimulation. Several studies have shown that malnourished children who were given verbal and cognitive stimulation had higher growth rates than those who were not (Agarwal DK, Awasthy A, Upadhyay SK, Singh P, Kumar J, Agarwal KN 1992). Breastfeeding is a simple way of providing both support and stimulation.

Care and support for mothers are closely linked to the health of infants. This care and support include reducing their workload, giving adequate time for rest, adequate quantity and quality of food and skilled health care. All these aspects of care and support greatly affects the birthweight of the infant, the nutritional status of it as well as the general health status. There are several challenges related to these aspects. In many cultures, there is an unequal division of labour, and women alone carry the burden of household maintenance. Because of this both they and their caring role suffer. Cultural norms and misconceptions affect the care women receive during pregnancy. In some cultures in parts of Asia, fish, meat, eggs and fat are withheld from pregnant women, because it is feared they will make the baby too large and difficult to deliver (Ali NS, Azam SI, Noor R 2004). But research shows that better maternal diet can improve the birthweight of children in many cases without causing significantly increased head circumference of the newborn, which is the factor most likely to put small women at risk (Begum N, Hussain T, Afridi B, Hamid A 1991).

Inadequate education for females is the most important single cause of inadequate care for children. Education improves their abilities and behaviour in health matters in general; nutrition, sanitation and disease management in particular. It has been suggested that for every year of normal schooling for girls, a reduction of 10% in infant mortality be reasonably expected (Amonoo-Lartson R, Ebrahim GJ, Lovel HJ 1985). In Indonesia and Pakistan, the infant mortality rate of children whose mothers had four years of schooling or more was found to be only 50% of that of infants born to illiterate mothers (Morley D, Lovel H 1986).

The basic cause of malnutrition in the conceptual framework is: "Quantity and quality of actual resources – human, economic and organizational – and the way they are controlled". And the cause underlying this is: "Potential resources: environment, technology, people". Political, legal and cultural factors at the national and regional level greatly affect child malnutrition, by affecting the three components of food, health and care. These include the degree to which the rights of women and girls are protected by law, the political and economic systems that determines how income is distributed, and the policies that govern the social sectors. For example, in societies where it is known and accepted that women in the late stages of pregnancy need rest and protection from overwork, families are more apt to receive the social support they need to ensure this protection. In cultures where there is a tradition of non-discrimination against women in law and custom, women are more likely to have good access to resources and to the decision-making power that can enable them to make the best use of services for themselves and their children.

5. Conclusion

In Moongilpallam 57.9 % of the children were wasted, and this was the village with the highest prevalence of wasting. Some of the contributing factors to this high prevalence included: low income, little access to food, a 100% illiteracy rate and poor medical facilities and sanitary conditions. According to the conceptual framework developed by UNICEF, these are the some of the main causes underlying malnutrition. They are all connected, and are some of the main symptoms of an underdeveloped society. There are different strategies to improve the living conditions and the quality of life in these areas. It is obvious that providing food, clothes, medicines, better housing and improving sanitary conditions have huge effects on the nutritional status of the children, as well as the conditions in the rest of the society. In an acute situation these efforts are invaluable. But these interventions are all short-term, and do not necessarily bring a lasting change for the better. If this is the aim, then long-term intervention is needed. Maybe the most important of these long-term interventions is education. Education creates whole new opportunities not only for the child itself, but also for its family and its village. It is not only a mean to get a job, which brings regular income, but it also creates a change in the mindsets of the children. Education strengthens the children's confidence in themselves, and brings hope and faith in the future. Then hopefully they can be the mediators of lasting change in the villages and cities.

Long-term intervention is more demanding and requires commitment and perseverance on a different level than the short-term interventions. I wish to thank Dr. Bevin Lawrence, his wife Serena, and the rest of their family for modelling this. By offering the children from the villages around Kodaikanal an opportunity for education, you bring hope and faith in the future.

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Appendix 1: Photos from the different locations



Photo 1. The children living in the TEAM Vision Hostel, some of their family members and supporters are gathered for Christmas celebration.



Photo 2. Some of the children from the TEAM Vision Hostel are doing their laundry.



Photo 3. Some of the children from the TEAM Vision Hostel are doing their homework.



Photo 4. Some of the children from the TEAM Vision Hostel are cooking food.



Photo 5. The children and their parents in Kadamanevu are gathered for the data collection.



Photo 6. Happy children in Kadamarevu.



Photo 7. A mother and some children in Kadamarevu.



Photo 8. Two girls from Kadamarevu.



Photo 9. A thirteen year-old girl from Koimbakadu who had been suffering from tuberculosis.



Photo 10. The parents of the children in Koimbakadu are being questioned, and the children's height and weight are measured.



Photo 11. The children who attended the school in Kumbur, where we did the data collection.

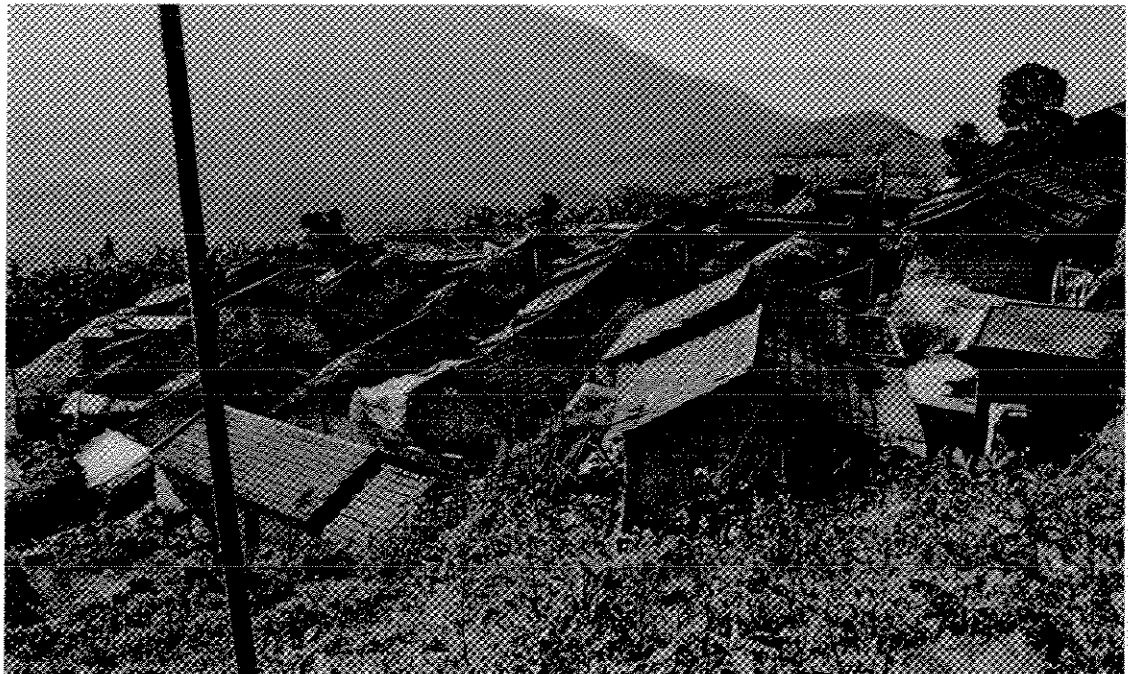


Photo 12. Kumbur had a higher standard than the other villages we visited. The houses generally were larger, and had thin sheets for roof.

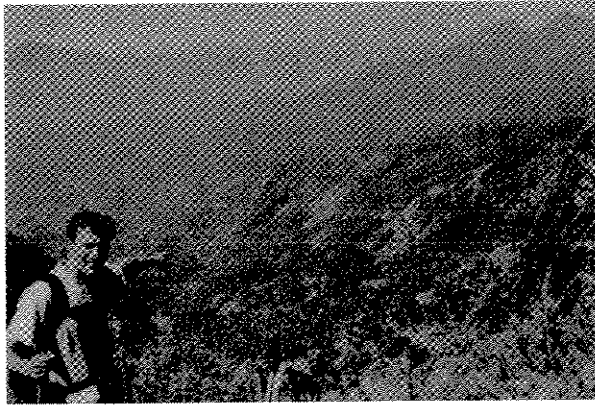


Photo 13. Moongilpallam was situated in a deep valley, and you had to walk 3-4 hours from the main road to reach the village.



Photo 14. Some of the children we assessed in Moongilpallam.



Photo 15. Some of the children we assessed in Moongilpallam.

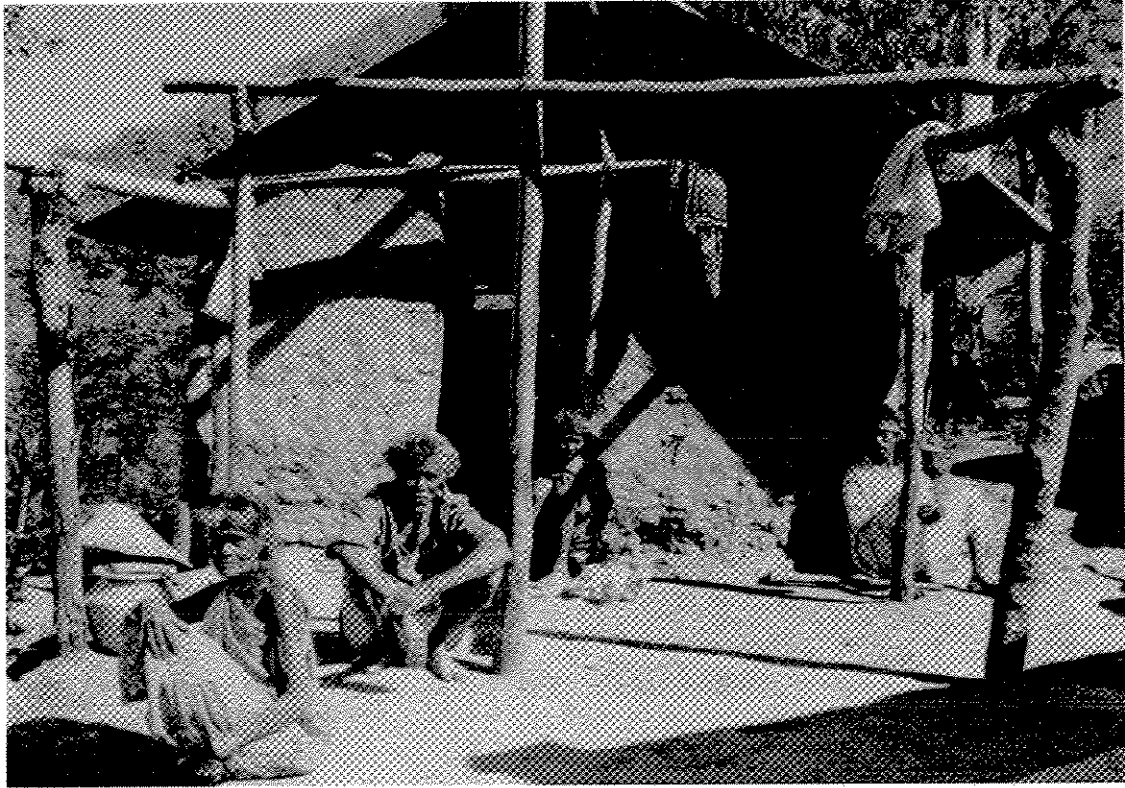


Photo 16. An elderly couple sitting outside their house.



Photo 17. Dr. Bevin Lawrence are giving a young girl a Vit.B¹²-injection.

Appendix 2: Questionnaire

MALNUTRITION IN THE AREA AROUND KODAIKANAL

- Village:
 Sheet nr:
 Para-medical visits:
 Children with literate mother:
 Children with literate father:

Nr.	Sex	Age	W	H	PA	SA	SD	BO	DA	Family history	Reg. inc.	Illnesses + Treatment	M D	Type food	Vacc	

W:weight, H:height, PA:parents alive, SA:siblings alive, BO:birth order, DA:delivery age, Reg.inc: regular income, MD:meals per day

Vacc:vaccines received