FOOD CONTAMINATION IN RELATION TO DIARRHOEA

A study in a rural Village in the Philippines

by

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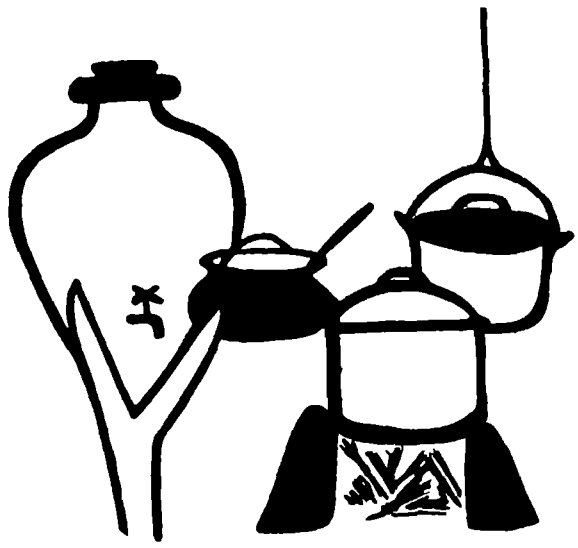

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OVERVIEW

A crucial question from the point of view of child nutrition is whether supplementary foods can be contaminated to such an extent that they increase the risk of diarrhoea. Infection, and particularly diarrhoeal infection, is assumed to be the most important cause of malnutrition (37).
In several studies associations between food contamination and diarrhoea have been put forward (5,12,37,50). However, no follow-up was done of children who actually consumed the food to assess direct causal relations. In the present investigation the occurence of diarrhoea has been assessed within a week after ingestion of the analysed foods, in order to detect direct causal relations at the individual level.
In San Isidro, a typical rural village in the Philippines a longitudinal observational study of six months duration was conducted to assess the relation between food contamination and diarrhoea. In this study 34 children were included in the sample; 16 children in age group 0-6 months and 18 children in the age group 11-13 months. Data of 122 children under 3 years of age on dietary patterns, growth and health were collected in the same village. The sample proved to be representative for the village.

Living conditions in San Isidro are poor; 85% of the houses are built of light materials. Untreated water is fetched from pumps or springs. Only 15% of the houses have a water sealed toilet. Garbage disposal is open. Electricity was not available until recently.
Financial security is low. Average income is 450 P a month (offical minimum daily wage: 20 P). Partial unemplyment is common, about half of the fathers work as irregular labourers in agriculture or miscellaneous jobs. Practically all the mothers in the sample are housekeeper (94%).
Mothers and fathers seem to be relatively well educated; only 12% of the parents have no schooling.
Childcare seems to be good despite the constraints of poor living conditions and lack of financial means. Attention is paid to the children when they are sick . 67% of the children in the 11-13 months age group have had vaccinations. Children are kept clean, relatively few children have worm infections. Mothers take good care of food for the children; it is usually stored for less than 2 hours between cooking and consumption. Breastfeeding is practiced widely, only 20% of the age group 0-6 months receives milk-bottle feeding.
Supplementary feeding is introduced from 2-6 months.
Like elsewhere in the Philippines, widespread chronic malnutrition is a problem in San Isodro (1,54). Only 10% of the children have normal nutritional status, 50% is moderately or severely malnourished ($<$75% W/A FNRI standard).
Compared with other countries prevalence of diarrhoea is low; in the 0-6 months age group the children suffer diarrhoea 4% of all days of observation. In the 11-13 months age group this percentage is only 1,5 (9,10,51). Upper Respiratory tract Infection (URI) accounts for 25% days of illness Diarrhoea in our research setting does not appear to be related to nutritional status and infant growth, nor to hygiene standard, income or educational level of the mother.

PREFACE

Participation in a research-project is a requirement in the curriculum of the study medical-Biology. In the Medical faculty it is stimulated.
In the beginning of 1982 we (Anita Hardon and Eldine Oosterberg) started to think about doing together practical work in a developing country. We thought we could work together succesfully and moreover, we knew each other since our high-school years.
Eldine, who studies Medicine could investigate health problems; Anita, who studies medical-Biology could take part in the laboratory related aspects illness-health.

Professor Dr. J.A. Kusin, head of the Subdepartment of Nutrition, Royal Tropical Institute (RTI), Amsterdam, suggested the topic of "malnutrition of 0-3 years old children in relation to morbidity". We intended to pay special attention to the relation food contaminiation and diarrhoea.

The agreement and support of Dr. J.S. Eusebio, Human Ecology Institute, University of the Philippines, Los Banos, and Dr.M. Nube, Food and Nutritin Planning course, University of the Philippines, Los Banos were obtained to conduct the investigation in the Philippines.

The research proposal had been written before our departure to the Philippines. With the proposal we had been able to get some funding from the Subdepartment of Nutrition, RTI, to finance the research materials, salaries for fieldworkers and medicines for severely ill children.
We spent 8 months in the Philippines in the period October'82-May'83. Half November we started the pilotstudies, in December the main study was started. Half May we ended the research.
Before leaving the Philippines the results and preliminary conclusions were discussed with the mothers of the children in our sample and with the Human Ecology Institute - and FNP staff.

The final report has been written in the Netherlands, as the principal supervisors of the research project were there.
The report is divided into two separate parts as we worked with different objectives. These two reports can be read separately.
The following report (report I) deals with the relation between food contamination and diarrhoea in infants.
Report II describes dietary patterns, morbidity patterns and growth in infants and toddlers.

I. INTRODUCTION

In a longitudinal-observational study the relation between food contamination and diarrhoea has been assessed.
The patterns of food contamination and diarrhoea have been described and associations between these factors have been determined in order to contribute to the formation of hypothesis concerning these variables.

In other studies a relation between food contamination and diarrhoea has been put forward, based on the following associations:
- Diarrhoea peaks in the age group in which supplementary foods are introduced (5,12,37,50).
- Food contamination is high in the season when diarrhoea incidence is also high (5,12).
- The proportion of child's food containing E.coli is significantly related to the child's annual incidence of diarrhoea associated with enterotoxigenic E.coli (12).

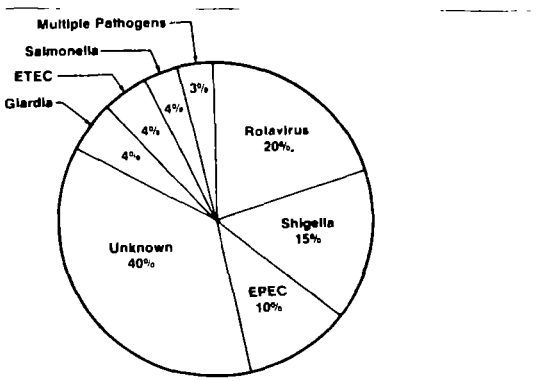
In these studies no follow up was done on the children who consumed the food. In the present investigation special attention is paid to occurrence of diarrhoea within a week after ingestion of investigated food, attempting to find direct causal relations between food contamination and diarrhoea at an individual base.
From the point of view of child nutrition in a public health setting the crucial question is whether supplementary foods (to breast milk) are so heavily contaminated that the introduction increases the risk of diarrhoea. Infection (especially diarrhoea) is assumed to be the most important factor in the causation of malnutrition (37).

- In this report first a review of relevant literature is given concerning the etiology of diarrhoea, defense mechanisms of the host and food contamination as possible cause of diarrhoea (chapter II).
- In chapter III the objectives of study are given.
- In chapter IV the methodology is discussed. First the approaches to reach the objectives are presented. If an approach did not prove to be workable this is mentioned in the relevant chapter. Further the method as planned before starting the study (planned method) and the method as actually carried out in the research setting (schedule of activities) are given. By making this distinction we want to contribute to methodology discussions.
- In chapter V and VI background information is given regarding the study area and the households involved in order to view the results of the study in general perspective.
- In chapter VII and VIII respectively food contamination and diarrhoeal patterns are discussed, paying attention to factors that can interfere in the relation between food contamination and diarrhoea.
- In chapter IX finally the relation between food contamination and diarrhoea is assessed. Attention is paid to the methodology used to assess the relation between the two variables and to the question: "are dirty calories better than no calories in our research setting"?

The etiology of diarrhoea

The problem of diarrhoea is complex, due to its multifactorial and often obscure etiology.
In 40% of the cases of endemic paediatric diarrhoea the infectious agent is unknown. Shigella and Salmonella, widely recognised as infectious agents, only account for 20% of the diarrhoeal cases (47) (Figure 1). Recently more attention is paid to enterotoxigenic E.coli, Campylobacter and Rota virus. Sometimes enteropathogens can occur in symptomless carriers (77).

Figure 1. Approximate relative importance of infectious agents in endemic paediatric diarrhoea (du Pont, 1980, 47)



In a study in Bangladesh an enteropathogen was associated with 50% of the diarrhoea episodes in children less than 2 years old, living in a rural community. Only a small fraction of these episodes was associated with the long known pathogens: Salmonella, Shigella and V.cholerae. A high proportion of the episodes was associated with the two recently recognised pathogens: E.coli and Rota virus. In 6% of normal stools a pathogen was found; in 75% of these cases enterotoxigenic E.coli was identified (9). Hence the occurence of asymptomatic carriers must be considered.
Also in Bangladesh infections with more than one pathogen were found in more than 20% of the cases (9). In Guatamala many agents were found in both diarrhoea cases and controls (37,39); multiple infections make it difficult to define the role of each pathogen in episodes of diarrhoea (47).
In Zaire Campylobacter jejuni was the most frequent recovered pathogen in children with diarrhoea. Enterotoxigenic E.coli was the next most common agent. Again Salmonella and Shigella did not play a significant role (41).
Differences between countries may be important:
In a comparison between Northern Nigeria and the Gambia Campylobacter was isolated more frequently from Nigerian children (34).
Rossi et al describe the syndrome of intractable diarrhoea in childhood. In most instances no etiological agent of diarrhoea was found in children of about 3 months, who have had diarrhoea for more than 2 weeks. They state that mucosal injury is an important cause. The injuring of the mucosal barrier by an unknown event leads to a vicious circle by which diarrhoea is perpetuated (49).

weaning foods as potential source of diarrhoeal pathogens.
Bacterial contamination of foods given to young children in Gambia was high (5,50). Contamination by Staphylococcus aureus, Bacillus cereus, Clostridium welchii, E.coli and Salmonella has been assessed. Standards from the international commission on microbiological specification for food (ICMSF), 1974, were used: food was regarded as unacceptable if it contained in excess of 10^3 - 10^5 bacteria / gram, depending on the type of bacteria. Likewise in Kenya high percentages of foods with bacterial counts above limit values were found. Foods were investigated for Enterobacteriaceae and Staphylococcus aureus. The limit values used were 10^3 bacteria/gram for Enterobacteriaceae and 10^2 bacteria/gram for S. aureus (61).
In both studies no follow up was done of children who consumed the food. The relation between food contamination and diarrhoea was not assessed. However, in Gambia a relation is suggested as food and water contamination levels were highest in the wet season, when diarrhoea incidence normally also peaks.
In Bangladesh transmission of enterotoxigenic E.coli diarrhoea in children was related to contamination of foods (12). The foods were classified as being potentially dangerous if any E.coli or faecal coliform was detected. The proportion of child's food that contained E.coli was significantly related to the child's annual incidence of diarrhoea associated with enterotoxigenic E.coli.
Food is suggested to be an important vehicle in the transmission of enterotoxigenic E.coli. Water was more frequently contaminated than food, but the number of E.coli in foods was 10 times higher than in water (12).
In Thailand diarrhoeal diseases were related to sanitation and water supply. A relationship between water quality, as measured with a coliform index and the incidence of diarrhoeal cases was found.

A few statements:
"Feeding babies with any food other than breastmilk is bound to be hazardous" (50).
"Consumption of such food and water is likely to increase the risk of acquisition of enteropathogens normally spread by faecal oral route" (12).

Comparison of the studies of food and water contamination is still difficult, as different reference values are used and contamination by different bacteria is assessed. Reference values for household surveys in warm and humid tropical countries have not been developed yet.
Only associations between contaminated water and food and overall diarrhoea incidence have been found, but causal relationships at individual basis have so far not been studied. To detect causal relationships between food-contamination and diarrhoea is a difficult task. Considering the complex etiology of diarrhoea the relative importance of contamination of weaning foods can be questioned. Furthermore, due to protective effects of host defence mechanisms it can be assumed that not all contaminated foods will lead to actual infection.

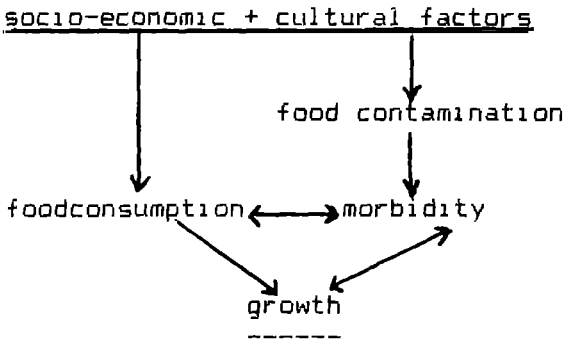
The weanling's dilemma (50)

The results of studies on the relation between infection and malnutrition and the studies on food contamination have led to a discussion on the appropriate time for the introduction of supplementary foods (supplementary to breastfeeding).

III.OBJECTIVES

To have an impression of the role of the various factors in the pathogenesis of malnutrition a longitudinal observational study among pre-school children is proposed. The interrelationships and associations between these factors are shown in the following scheme.

Figure 2. Pathogenesis of malnutrition



The objectives of the study are:

1. To assess the relation between food contamination and (weaning) diarrhoea in infants.
2. To observe and describe the dietary patterns,morbidity patterns and growth in infants and toddlers.

Dietary patterns, morbidity patterns and growth in infants and toddlers have been examined in 122 households by E. Oosterberg (73). This report deals with objective 1: The relation between food contamination and diarrhoea.
Some socio-economic and cultural data have also been collected as these factors can interfere in the relation between food contamination and diarrhoea.

Central study

To assess the relation between food contamination and diarrhoea it describes:

- Food contamination patterns:
  . contamination by disk and drink
  . contamination by meal
  . contamination by season
  . contamination by area
  . contamination by storage time
  . contamination of fingers
  . factors influencing food contamination

- Diarrhoeal patterns:
  . diarrhoea in relation to age, season, feeding pattern, degree of malnutrition, hygiene, income and education
  . the characteristics of the diarrhoeal cases

- Relation between food contamination and diarrhoea, by determining:
  . if in households with generally a high food contamination load, more diarrhoea occurs than in households with generally low contamination load of foods.
  . if consumption of a heavily contaminated meal (more than 10^4 Enterobacteriaceae per gram, or more than 10^3 Staphylococci per gram) is followed by diarrhoea in the following week.
  . if there is a 'cut-off' point in contamination load, above which consumption of the food almost certainly leads to diarrhoea.
  . if an incidentely high contamination load of food, that is high compared with 'normal' for the specific household, leads to diarrhoea.
  . if infants, age 2-3 months, getting supplementary foods get significantly more diarrhoea than their exclusively breastfed age-mates.

Note: This study has to be considered as a contribution to the formulation of hypothesis. There are still no standardised methods to assess the relation between food contamination and diarrhoea, so the methodology followed will be discussed extensively.

3. Planned methods

Pilot study

- Sample N = 4 households, of which 2 with a relatively high hygienic standard and 2 with a relatively low hygienic standard. The differentiation is made by use of the following criteria:
  . toilet present
  . source of water
  . educational level of care taker

  Each of the mentioned groups (N=2) includes one child of 2-3 months receiving cow's milk or milk formula feeding, and one child of 7-8 months receiving supplementary feeding consisting of cereals or family food.

The relative accuracy of the data are summarised in figure 3 (61).

Figure 3: Relative accuracy of different methods of inoculation

Method of inoculation	Levels of accuracy	Coefficient of variance (%)
Conventional plating	1 = laboratory quantative	c. 10
Immersion	2 = Laboratory semi-quantative	c. 30
Contact	3 = field	hardly quantatifiable because extreme variation in transmission of organisms

The following limit values are suggested for the interpretation of the bacterial colony counts obtained from foods and water (Figure 4) (60).

Figure 4: Limit values contamination level of foods and water (60)

Type of slide and type of material	Sound	Contaminated	Severely contaminated
E slide : river and well water	$\leqslant 10^3$	10^4	$\geqslant 10^4$
cooked foods	$\leqslant 10^2$	10^3	$\geqslant 10^3$
ST slide: river and well water	$\leqslant 10^2$	10^3	$\geqslant 10^3$
cooked foods	10	10^2	$\geqslant 10^3$

- Contamination of food and jarwater:
  In the laboratory the samples chosen for plating are diluted (10^{-7}) by means of shaking with glass beads in a sterile container. Only water is not diluted. Then the samples are inoculated by use of a 2 ml syringe. The needle functions as spreaderbar. The syringe is sterilised with alcohol 70% and formaldehyde 4% and rinsed with the foodsample dilution. Two drops of each dilution (0,02 ml) are plated on the two different slides (in duplo).
  After 24 hours incubation at 37° C typical colonies are read on the E-slides. After 48 hours incubation at 37° C typical colonies are read on the ST-slides.
  The approximate number of colony forming units (bacteria) per gram of the original sample is calculated from the number of colonies on the slide, multiplied by a factor (depending on the quantity of fluid inoculated and the dilution used; for 0,02 inoculum and 10^{-7} dilution the factor is 500).

- Contamination of fingers and pumpwater:
  On the spot investigation is done. All five fingers of mother and child are pressed on the agar slides for contact examination.
  For pumpwater the immersion method is used: the slides are dipped into a sterile container filled with pumpwater.

The interpreter checked if the mothers had followed our instructions by interviewing them, when we came to fetch the ice boxes. Some families we visited at eating time to check whether the instructions were followed. We asked the mother how long food was stored between cooking and consumption.
An advantage of this sampling method was that we did not have to sit in their houses waiting for the child to be fed causing a lot of bias.
The samples were transported to the laboratory with the last jeepney at 5 pm, reaching the laboratory at 6 pm. The temperature in the iceboxes never reached values over 6 C at the end of the day.
In the second period the samples were collected between 8 am and 3 pm daily, covering at least lunch and one snack. During the first period it had proved to be impossible to develop criteria to predict which sample was most contaminated. So in the second period the samples investigated were not chosen by criteria for probable load of contamination, but by kind of meal sampled: lunch and a snack were investigated, as well as one water sample.

- Assessment of food contamination:
The planned method was largely followed. Some experiments were done with plating techniques, resulting in the conclusion that milk should also be diluted (10^{-7}) to prevent uncountable large number of colonies.
Apart from this point the planned method seemed useful.

- Premilinary conclusions:
  . The mothers can do the food sampling themselves.
  . The method planned to assess food contamination is applicable.
  . It is hardly possible to find criteria with which one could predict the most contaminated feeding sampled during the day.
  . Within household variation in contamination load is big compared with between-household variation. It will be difficult to categorise the households with respect to food contamination.

Central Study

- Sample:
For the choice of the sample consideration had to be given to the type of food pre-school children receive. We intended to investigate supplementary foods. breastfeeding in San Isidro is given up to 16 months. So age groups were chosen in this time range. It proved to be impossible to choose the groups as planned, because there simply were not enough children in the age groups mentioned, and formula feeding is rarely given (see paragraph 3b). The following age groups were chosen:
  . Children up to 6 months, getting relatively little family food, mainly plain rice, some milk as supplementary feeding: N = 20.
  . Children of 11, 12, 13 months getting mainly family food as supplementary feeding: N = 20.

4 children in the younger group and 1 child in the older group got bottlefeeding instead of breastfeeding. 4 children did not get breast- nor bottlefeeding,they had switched entirely to family food. 2 children were exclusively breastfed.
We decided to sample the whole age group, except of course the exclusively breastfed children.

6. Interview

To get information on socio-economic and cultural factors an interview was held, once in the last month of study. The preceding months, however, were used to make observations and design the final questionnaire. In the first month every day during the visit rounds one household was observed for about an hour considering housing, hygiene and childcare. Talking with the mothers and fathers gave us much background information. This schedule was followed during one month. In the second month the final questionnaire was designed and it was tested in the third month of study. During this period also more in depth observations were done on hygiene and child care. The final interview was held in the fifth month in all 122 families of the larger sample: children 1-3 years of age. The description given in this report is based on the data of the subgroup of 34 children for food contamination investigation, a few times complemented by data out of the whole sample and interpreted using the observations made during the first months.

Figure 5: Health Statistics for San Pablo Municipality (information obtained from City Health Office)

A. Morbidity: 10 leading morbidity causes for 1982 (all ages)

	Number	Rate/100.000
U.R.I.	4,792	2,959.18
Parasitism	1,648	1,017.85
Gastroenteritis	1,370	625.04
Primary Complex	1,012	528.69
Bronchitis	856	411.34
Pulmonary T.B.	782	325.49
Anemia	666	295.84
Vit.def.	393	242.72
Influenza	327	201.96
Hypertension	252	155.64

B. Mortality: 10 leading causes of mortality (all ages)

	Number	Rate/100,000
Pneumonia	203	125.37
Heart Disease	190	117.34
Pulmonary T.B.	100	61.75
C.V.A.	82	50,64
Senility	77	47.55
Gastroentiritis	54	33.35
Violence/Accidence	85	52.50
Cancer	34	20.99
Prematurity	31	19.14
Congenital Debility	22	13.59

Population: 166.839

Figure 6: Malnutrition statistics for San Pablo Municipality in 1982 (53)

Overweight	:	8%
Normal	:	21%
1st degree malnourished	:	52%
2nd degree malnourished	:	13%
3rd degree malnourished	:	6%
		100%

VI. CHARACTERISTICS OF THE HOUSEHOLDS

1. Introduction

Socio-economical and cultural factors can interfere in the relationship between food contamination and diarrhoea. The hypothesis can be put forward that 'poorer' children will live in less sanitary conditions and receive less nutritious food than children in 'richer' families.
When looking for a specific relation between two variables (food contamination and diarrhoea) the influence of these confounding factors should be minimised.

San Isidro was chosen as a research area, because the difference in standard of living between families is not large.
In this chapter the households in which food contamination is investigated will be described, paying special attention to food hygiene. To contribute to the discussion on possible actions to improve the food hygiene in San Isidro some constraints and problems will be mentioned.

2. The family (-in general, and state of mother and child specifically)

Of the 34 families in our sample 28 families are nuclear and only 6 are extended. Family size distribution is as follows:

2-3 members : 7 families
4 members : 6 families
5,6 members : 7 families
7,8 members
or more :14 families

In 5 families the father is regularly away for a period of at least a week. None of the mothers are regularly away.

Education is distributed as follows:

	fathers	mothers
no schooling	2	2
not completed elementary school	6	8
graduated elementary school	19	19
not completed high school	4	2
graduated high school	3	1
advanced training	0	2

The mothers however, do not seem to benefit much from their education in terms of paid employment: 32 of the 34 mothers are housekeeper. 1 mother owns a small store and one mother is rice labourer.
Of the 34 fathers 16 work as labourers in agriculture (rice or coconut) or have miscellaneous jobs. The rice and coconut labourers do not have much financial security: they do not have working contracts. 6 fathers are tenants in rice culture, 6 are government employees and 6 are engaged in private business.

3. The family resources

Income distributed as follows:

less than 300 P/month	13 families
300-699 P/months	15 families
700-999 P/month	2 families
1000 P/months or more	4 families

The mean income is P 450 per month. The data on income, however, can not be considered very reliable. Most of the families do not have a regular income. The impression is that the respondents viewed their income rather optimistically giving us an figure for the months that they were actually employed. Minimum wage for one day work in the Philippines is around 20 P. 13 of the families in our sample are clearly under the minimum income. Accounting for the optimistic view the families with and income of 700 P or more are categorised as relatively 'rich' families (6 families).

Properties:
Most of the families studied own the house and enjoy a rent-free lot on which they live (28,34). Rent-free seems perfect but in reality means that the owner tolerates the family on his land, but the family has no rights. If the landowner wants to use the land for another purpose they will have to leave. 6 families either own (3) or rent (3) the land, giving them more security. 4 of these 6 families are relatively rich (earn more than 699 P per month).
28 of the 34 families live in a house built of light materials (bamboo-nipa) usually consisting of one room on poles and a kitchen attached at ground level. Only 6 families live in concrete houses (partially or totally built of bricks). This is especially an advantage during typhoons. 5 of these families earn more than 699 P per month: living conditions of the richer families are better.
Most families in San Isidro own a radio (30 out of 34). However, only 6 of these families own more appliances. 4 families do not own any appliances.
Only one family owns a transport facility (bycicle). 27 families have chickens and/or pigs. 7 families have no animals.

4. Running the household

Spending the income:
Data on expenditure are presented in percentages that the families spend on different items (see figure 9)

The mothers say that it is difficult to keep their children clean: there is always dust and mud around, especially in the bamboo houses. The kitchens in these houses do not have a cemented floor and as soon as the children can move around, it is difficult to keep them in the relatively clean 'sleeping room'. According to the mother "To keep children healthy you must keep them clean. You must wash the children at least daily before they go to sleep, otherwise the children will scratch insect bites at night". According to the interview the mothers wash their children 4-5 times a week on average (ranging from 1-14).
At the age of 2-4 months the children start getting supplementary foods. Before starting with solid foods the children are given ricewater or milk (formula - or condensed -). At the age of 5-7 months nearly all children get supplementary foods. At the main meals rice is mostly given, mixed with a small piece of fish, vegetables or only some soya sauce for the taste. From 7 months onwards bread and biscuits are given as snacks. Child illness is also a problem for the mothers (see above). When the child is ill the mothers go to the health centre in San Isidro or to town to a private hospital or the free malward. Some mothers visit the arbolario (herbalist) in the village.

Causes of diarrhoea according to interview in the larger sample of 122 households are (73):
- food according to about 50% of the mothers:
  . kind of foods (green banana, sweets, coconut etc.),
  . inadequate food,
  . too much eating,
  . spoiled fruits,
  . raw foods.
- theething
- tiredness of mother (less or bad breastmilk)

Hygiene, with special attention for food hygiene:

Mostly the whole family sleeps in one room. This crowding increases the family infection risk.

Most of the families use an open pit toilet (26), only 5 families have a water sealed toilet, 3 families use no toilet.
4 families throw the garbage around haphazardly, 30 families burn, bury or give it to the pigs.
Source of drinking water is an artesian well at 5-200 meters from the house (31 families). 3 families fetch water from a spring.
Distance to the pump could be an important factor in the quality of the household water supply: if a pump is further away, fresh water is fetched less often. In the households drinking water is fetched between 1 and 28 times a week. This water is stored in jars with a cover and a tap. Water for cooking and cleaning is kept in larger open jars.
Mostly 2-3 glasses are used for the whole family during meals: half of the respondents say that they use individual glasses at meals.

The following constraints were observed or experienced:
- water supply; water pumps are at a distance of 5-200 meters from the houses.
- food supply; especially with regard to fish (fish has to be bought at the market, costing 3.80 P transportation with the jeepney).
- food storage;
  . no refrigeration is available, ice has to be fetched in San Pablo and costs about 2 P for 10 l.
  . food has to be protected from rats, flies, ants, cockroaches and other animals; a cabinet to protect food from these animals is a big investment.
- Domestic animals are kept all around the house. They can enter the kitchen and do so to eat up bits of foods that have fallen on the floor. They keep the kitchen clean in a way (especially pigs) but of course also cause a lot of contamination. Animals bathing in the water of the drain coming from the pump can even cause the ground water (drinking water) to be contaminated if the surface water is not filtered enough before it reaches the ground water level.
- Mothers economize on the use of soap.
- During the dry season the area is dusty, during the wet season the area is muddy. The kitchens mostly have an earthen floor, so this limits kitchen hygiene.
- Cooking on wood requires a lot of time: It is not an easy task to reheat some food, or boil water before consumption.

Adaptations:
In our eyes there are many contraints in the village environment. Hygiene is poor. However, it seems that under the circumstances the villagers do the best they can. They have adapted to their environment.
Some of their principles/practices:
- Fish should be cooked immediately after purchase at the market. It should be salted thoroughly
- Fish should be cooked anew each meal.
- Food must be protected from animals by a cover. It is best to hang the pan from the ceiling, if you don not have a cabinet.
- Drinking water should be fetched daily from the pump and put in a covered jar.
- Left-overs should not be kept for a long time (not more than a day). Left-overs must never be given to young children.
- Water used to clean the plates, together with food that has been spilt during the meal can be fed to the pigs.

5. Concluding remarks

The 34 households are more or less homogeneous with respect to the variables like income, properties, education and hygiene. The results from the larger sample of 122 households did not differ significantly from findings in the sub sample (73).
Hence we consider the characteristics more or less representive for San Isidro. San Isidro is a typical rural village in a coconut growing area. Problems of low financial security, bad living conditions, lack of sanitary facilities and malnutrition as described with respect to the 34 households seem to be common in the Philippines (see also chapter 5).

For contamination of fingers of mother and child three levels are proposed:
clean: 0 cfu/gram or ml
contaminated: 1-200 cfu/gr or ml
severely contaminated: more than 200 cfu/gr or ml

In the pilot study the levels used are slightly different. Each sample has been expressed in log (cfu/gr) making it easier to chart inter-and intra-household variation.

In the following chapter first the results on inter- and intra-household variation during the pilot study wil be presented, as they complement the data of the central study.
All conclusions of the pilot study are presented to indicate how the pilot study influenced the central study.

Secondly the central study on food contamination patterns is described. Results and interpretation are combined to clarify the presentation.

In the discussion some aspects of food hygiene are dealth with to indicate the variety of conclusions that can be drawn from the data collected.

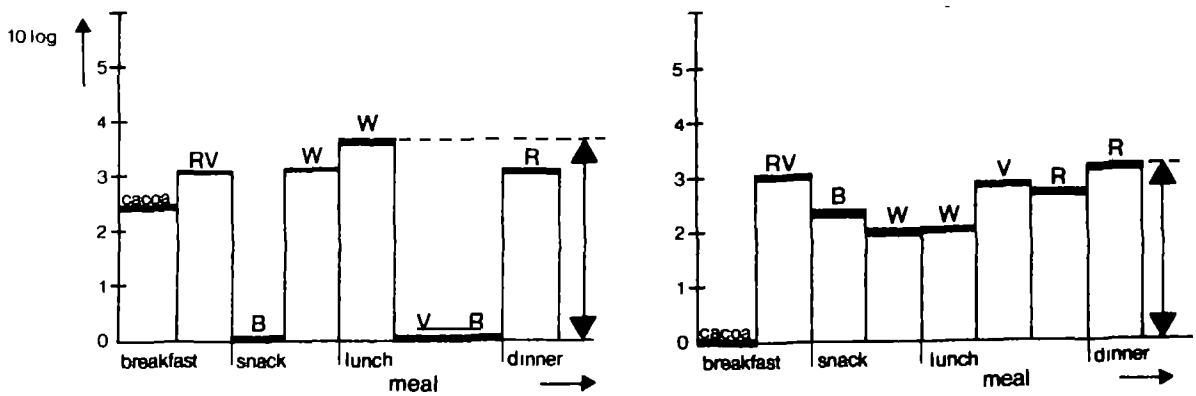
2. Pilot study

Results

The contamination load of supplementary foods and drinks varies considerably during the course of the day. Bacterial counts between less than 50 cfu/gram and approximately 10^4 - 10^5 cfu/gram were found in all four model families (see figure 12a and 12b).

Figure 12a. Intra-day variation in contamination of rice (R), Rice+vegetables (RV), Water (W) and cacao in one model family: Enterobacteriaceae

Fig. 12b. Intra-day variation in contamination of the same dishes in the same model family: S.aureus



The inter-day variation in contamination load of lunches given to the 'model' children, was also large.
Again bacterial counts between less than 50 cfu/gram and 10^4 - 10^5 cfu/gram were found (see figure 13a and 13b).

Conclusion

The pilot study was carried out to test the method proposed for the central study. The main objective was to find out whether the contamination load of children's food in households is a useful indicator for the likelihood of intestinal diseases.
The approach adopted to collect data has been given in chapter IV paragraph 2.

Main conclusions are:
- Variation during the day is of the same order as the day to day variation.
- The variation within households is larger than the variation between households.

The pilotstudy did not give tools to predict which feeding of the child is most contaminated by use of the following criteria:
- storage time
- storage circumstances
- preparation manner (see appendix 2)

No strong relationship was found between storage time and contamination load, probably because the storage time generally did not differ much: never longer than 4 hours, usually 0-2 hours.
The storage circumstances were homogenous in and between families. Cooling was not possible due to lack of electricity.
Concerning preparation manner, there were not enough samples to determine the difference in contamination of cooked and dried foods. Generally the children got a mixture of rice and vegetables or fish. Preparation manner in the pilot study did not seem a useful refrigriation facilities.
Type of food can be used as a criterion. It seems advisable to investigate cooked foods, water and milk in the families. Biscuits should only be investigated if there are no other specimens, because the level of contamination of biscuits is lower than that of cooked foods, water and milk.
The method to assess food contamination seems feasible.
It seems, however, likely that the distinction between "clean" and "dirty" households will be difficult to make, because the intra-household variation is large compared with the inter-household variance. No patterns were found in the sample except for type of food.
Hence the present preliminary data did not provide a framework for a more systematic method of sampling.
For further information on inter-day contamination patterns it seems advisable to sample breakfast and dinner at least one time in all the households. Lunch can be sampled each time. Sampling should primarily concentrate on cooked foods, milk and water.

Fig.15a: Contamination of Rice, Rice + and Milk: Enterobacteriaceae (total 255 samples)

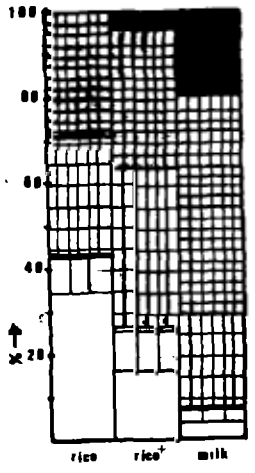


Fig.15b: Contamination of jar water and pump water: Enterobacteriaceae (total 174 samples)

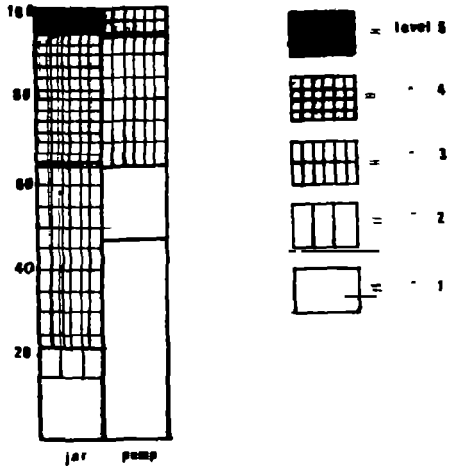


Fig.16a: Contamination of Rice, Rice + and Milk: S.aureus (total 255 samples)

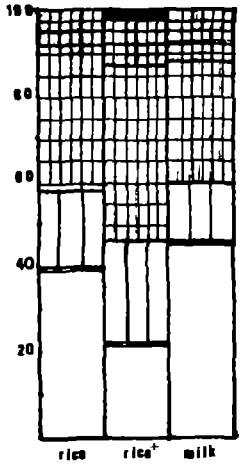
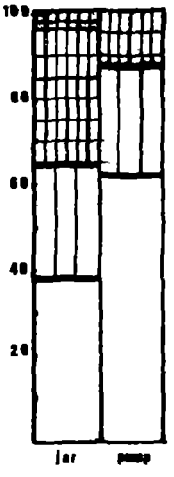


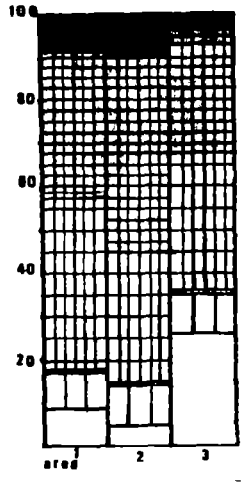
Fig.16b: Contamination of jar water and pump water: S.aureus (total 174 samples)

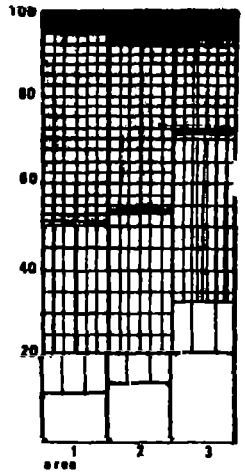


- Contamination by meal (intra-day pattern)

There seems to be a trend in the intra-day pattern of contamination: breakfast is more contaminated than lunch, while dinner is less contaminated than lunch. The differences, however, are not significant.

Fig.18a and 18b: Contamination by area: Enterobactriaceae for water and total samples.





area 1: lower land rice field
area 2: intermediate
area 3: slope of the mountain

Colonization by storage time

The cooked foods sampled had seldomly been stored for more than 3 hours. 82% of the samples were stored less than 2 hours, 28% of the samples only half an hour or less.
Only a slight influence of storage time is seen in water samples contaminated by S.aureus. No influence is seen for rice and rice +.
For Enterobacteriaceae the influence can also mainly be seen for jar water: Water stored for more than one day has a higher degree of colonisation than jar water fetched the same day. For Rice + there is a slight trend.

- Contamination of fingers of mothers and children

As the contact technique of the AIPC slides was used, only an impression was obtained of the contamination of fingers.
The results are shown in figure 19a and 19b.

Enterobacteriaceae:
The fingers of the children are clean in approximately half of the cases measured. The fingers of the mothers are clean in approximately a third of the cases measured.

S.aureus:
Both the fingers of mothers and children are highly contaminated, respectively 95 and 93% of the fingers can not be considered clean.

To prevent contamination of foods it is important to:
- have clean raw foods and water
- heat the foods adequately
- avoid recontamination of the heated food (by fingers, dirty utensils, other raw foods, animals)
- store adequately (cooled, inaccessible for animals etc.)

Based on the above it is possible to discuss the patterns found:

- Contamination of dishes and water

Enterobacteriaceae:
Rice only is treated hygienically under the circumstances. It is washed before cooking and boiled for at least 20 minutes, than left on the fireplace (or on the kitchen table) usually with a cover. The recontamination possibilities are not too many. Nevertheless the percentage of samples with unacceptable levels is high. When some vegetables or fish (sometimes left overs) are mixed with the rice, recontamination can occur. Further rice + could have more favourable nutrients (for bacterial growth). Rice + is more intensively manipulated. This could explain why rice + seems more contaminated than rice only.
Milk is prepared with unboiled, contaminated water. Further milk is a good medium for bacterial growth (many nutrients high water activity). This could explain why milk is highly contaminated, and shows a significant difference with both Rice only and rice +.

S.aureus:
Rice + is highly contaminatd with S.aureus. The same explanation as above could be given.
Milk, however, contains significantly less S.aureus. This could be due to the competition by Enterobacteriaceae (S.aureus is known to be susceptible to competition of other bacteria, appendix 1). S. aureus is also known to favour low water activity of foods: Milk does not seem to be a favourable medium for S.aureus.

- Seasonality

Enterobacteriaceae:
No seasonal influence is found. This could be due to the fact that both seasons have something favourable for Enterobacteriaceae:
The rainy season is more humid, the dry season is hotter.

S.aureus
For S.aureus there is a significant seasonal influence. It seems that S.aureus favours the cooler rainy season. (S.aureus tends to multiply in humid surroundings as the human nose.

- Contamination by area

In area 3 the ground water is deeper. The surface water has more time to become filtered before reaching the water level. Bearing this in mind it is understandable that this area delivers cleaner water samples. Possibly the pump differs from the pumps in the lower areas in more characteristics than depth. The quality of the pumps also plays a role.

and Bangladesh, we assume that more or less the same counts would have been found.
In the Gambia contamination was found to be significantly higher in the rainy season. This is in agreement with findings in our study. Further in Bangladesh, Kenya and the Gambia a relation between contamination and storage time was seen (cooked foods were found to be stored upto 8 hours). No such relation was found in the present investigation, probably due to the fact that storage times of cooked foods are relatively short in San Isidro (mostly less than 2 hours) (5,12,50,61).

asked as stools containing blood or pus are reckoned as diarrhoeal cases according to our definition.
Foul smelling could indicate bacterial infection (information Paediatrician Malward) and acid smelling, due to acid stools, could be associated with rota virus and C.jejuni, although a relation is also found with breastfeeding and young age (63).

Fig. 20: Smell, colour and nr.of stools in the diarrhoeal spells (N=34)

Nr.of stools in 12 hours	Characteristics						
	Foul smelling		Acid smelling		Normal smelling		Total
	yellow	green	yellow	green	yellow	green	
3-5	9	6	6	7	3	0	31
more than 5	1	0	0	1	1	0	3
Total	10	6	6	8	4	0	34 +

+ 4 cases unknown

No bloody stools were recalled, nor stools with pus. The predominant colour of the stools during the diarrhoeal cases was yellow and green. Both foul and acid stools are found, indicating possible bacterial infection .
Diarrhoea with more than 5 stools during 12 hours seldom occurred.

- Symptoms accompanying the cases

Figure 21: Symptoms accompanying the cases (in brackets the cases in the second group)

Accompanying symptom	nr. of cases	
None	21	(3)
Fever only	7	(4)
Vomiting only	6	(1)
Pain only	1	
Vomiting and fever	2	
Pain and fever	1	(1)
Vomiting and pain	1	
Total	38	(9)

Additional information: The diarrhoea spell lasted more than 3 days in 3 cases. Anorexia accompanied the diarrhoea in 4 cases.
In 17 cases diarrhoea is accompanied by fever and/or vomiting and/or pain with defaecation. These cases are considered more serious than diarrhoea with no symptoms (21 cases), as fever could indicate a bacterial infection, vomiting a food intoxication etc.

of illness days with diarrhoea was 16.7 and in the 12-23 months age group it was 13.3 (9). This is clearly higher than the percentages found in San Isidro.
Also in the Gambia a high incidence was found in comparison to San Isidro: in a cohort of children 2 months to 3 years of age percentages between 9.2 and 21.2 were found depending on the season (51).
The low percentage of illness days with diarrhoea in San Isidro is due to the fact that many diarrhoeal spells do not last longer than 3 days (53%) In general the percentage of illness days with upper respiratory tract infection is much higher (e.g. 25% for the 0-3 years cohort (appendix 2, table 2).

Figure 22-24 Contamination of food, jar + pumpwater contamination in relation to percentage days diarrhoea: rs = spearman rank correlation
N = number of children

Fig.22a.: Enterobacteriaceae food contamination (N=16): rs=0.07

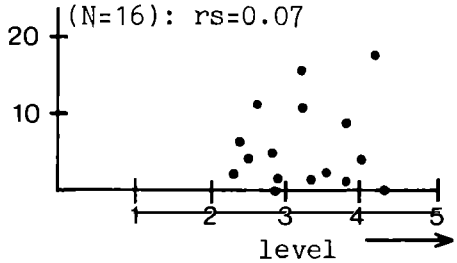


Fig.22b.: Staphylococcus aureus food contamination (N=16) rs=0.05

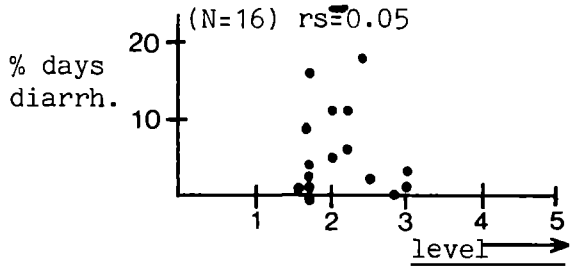


Fig.23a.: Enterobacteriaceae jarwater contamination (N=12) rs=0.20

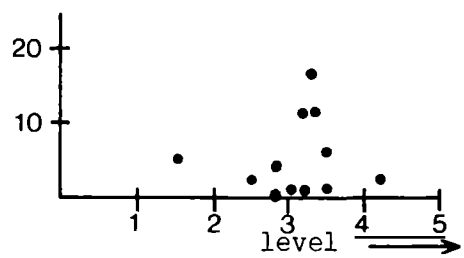


Fig.23b.: Staphylococcus aureus jarwater contamination (N=12) rs=0.23

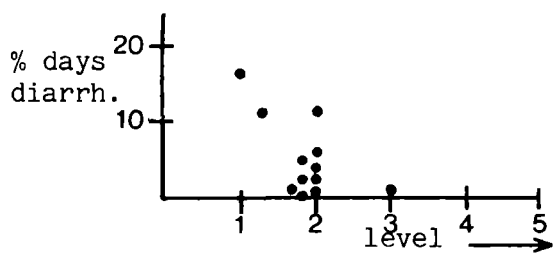


Fig.24 .: Enterobacteriaceae pumpwater contamination (N=12) rs=0.26

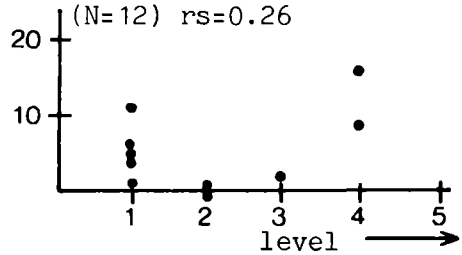
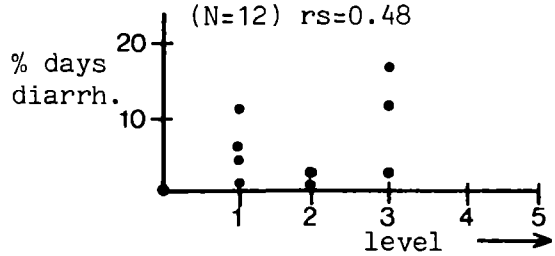


Fig.24b.: Staphylococcus aureus pumpwater contamination (N=12) rs=0.48



There are many possible explanations for these results:
- The marker organisms that we used (Enterobacteriaceae and S.aureus) are not specific enough. Highly contaminated food does not have to harbour pathogens; the risk of diarrhoea is not assessed quantitatively.
- The within household variation in food contamination is large compared to the between household variation. Therefore it is difficult to categorize the households. The households in San Isidro are so homogeneous with regard to mean food contamination that this factor cannot be used as an explanatory variable for differences between households in diarrhoeal incidence. The relation between food contamination and diarrhoea should be assessed in a group where larger variations exist in food hygiene between households.

Regarding diarrhoea it is important to mention that the percentage illness days with diarrhoea is low in our population. Therefore in the second age group correlations between mean food contamination level and diarrhoea could not be calculated. A longer study period would make it easier to differentiate the households with respect to diarrhoea. Further the diagnosis of diarrhoea is not accurate. The pathogenic agent of all diarrhoeal cases should have been assessed to be able to differentiate with regard to the etiological agent.
Facts can be obtained through a more indepth study in which specific pathogens in food are related to pathogens in stools of diarrhoeal cases. Attention should be paid to other transmission pathways (fingers f.e) and host characteristics (including mothers milk)

4. The weanling's dilemma

In the literature review the weanling's dilemma is discussed:
Since infection (esp.diarrhoea) is assumed to be the most important factor in the causation of malnutrition and the introduction of supplementary foods is suggested to incease the risk of infection with diarrhoea (5,12,51), late introduction of supplementary foods is recommended (60,68). The question is posed whether no added calories are better than dirty ones. As we could not find a direct causal relation between food contamination and diarrhoea nor correlations between mean food contamination and diarrhoea in the households we would suggest dirty calories to be better. In our research setting we would not advise the mothers to delay introduction of supplementary foods, as we do not assume that through this advise diarrhoea incidence would decline, improving nutritional state.
Furthermore we expect upper respiratory infection to be of more importance in the retardation of growth than diarrhoea. URI accounts for 10 times more illness days than diarrhoea and seems to be related to growth (appendix 2, table 9+10). In another study elsewhere in the Philippines cough, together with total illness days were found to be good indicators of nutritional status. Dietary interventions could improve nutritional status in infants of 5-12 months (3). In our study total illness days seems to be related to malnutrition (appendix 2; table 9). No such relation is found for diarrhoea (appendix 2, tables 4 -5).

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Appendix 2. Diarrhoeal patterns

1. Definition of variables
2. Tables
- table 1. Diarrhoea (Incidence, duration, percentage days ill and age at diarrhoea I in relation to feeding pattern, upper respiratory tract infection, nutritional status, income, hygiene and educational level based on 4,5 months follow up
- table 2. Incidence rate of diarrhoea in relation to age and season
- table 3. Percentage days ill with diarrhoea in relation to nutritional status (weight for age).
- table 5. Percentage days ill with diarrhoea in relation to growth
- table 6. Percentage days ill with diarrhoea in relation to income
- table 7. Percentage days ill with diarrhoea in relation to hygiene
- table 8 . Percentage days ill with diarrhoea in relation to education
- table 9. Percentage days symptomless in relation to growth.

2 = 61 - 75% of standard
3 = 60% and less of standard.

- Weight for height: same reference as above
  0 = standard
  1 = normal and up
  2 = moderately underweight
  3 = severe/wasted underweight.

- Growth rate for age: based on NCHS CDC antropometric reference.
  + = above standard
  - = below standard
  0 = no informatio n

1.3. Feeding pattern

- Exclusively breastfed = Br
- Exclusively bottle milk fed = Bo
- both breast- and bottle milk fed M
- Supplementation of rice, or rice with something else as fish and/or vegetables = +
- family food, without breast- or bottle milk = 0

1.4. Income

- less than 300 ₱ / month =11
- 300 - 699 ₱ / month = 2
- 700 - 999 ₱ / month = 3
- 1000 or more = 4

1.5. Education.

- less than 2 years elementary school = 0
- 2 years elementary school or more elementary schooling = 1
- 1 or more years high school = 2
- 1 or more years college = 3

1.6. Hygiene

a. Sleeping density: all in one room = 0
   not all in one room = 1
b. toilet facility : none = 0
   open pit = 1
   water sealed toilet = 2
c. water source : river = 0
   spring = 2
   pump = 1
d. times water fet-: 1 time = 1
   ched/day 22 times = 2
   3 times = 3
e. usage individual : no = 0
   glasses : yes = 1

2. Tables

Begin age	N	nr	Mean I'	Mean D'	Mean P'	Individual I	Individual D	Individual P	Diarrhoea at age	Nutr-state W/H	Nutr-state W/A	Nutr-state G	Soc-ec.	Hygiene	Education	URI P	Feeding
1-2	5	1	1,5	2	4	0			-	0	2	0	2	2	1	12,5	Br
		2				5,6	4	18	3,3,3,4,6	1	1	-	2	1	2	5	Bo
		3				0				1	2	-	2	1	1	35	M
		4				1	1	1	2	2	1	-	2	1	0	14	M
		5				1	1	1	4+	0	2	+	1	2	1	27	Br+
3-4	3	6	3,3	4,1	10	3,6	3	9	5+,6+	0	-	0	-	-	-	-	Bo
		7				2,6	8	16	4+,4+	1	0	+	2	2	2	73	Br+
		8				3,8	1,3	11	3+,3+,4+	1	1	0	-	-	-	-	BO
5-6	6	9	2,3	2,6	6	2,3	3	5	7+,8+	0	0	+	3	2	1	21	Br+
		10				1,1	2	2	8	1	2	-	3	2	2	11	Br+
		11				2	4	6	8+,8+	0	3	+	2	2	2	62	Bo
		12				4,6	2,8	11	5+,6,7	0	2	+	1	1	1	61	Br+
		13				2,1	2	4	6,10	0	0	-	2	1	1	41	Br+
		14				1,6	2	5	6+, 7	1	1	-	3	2	1	13	Br+
7-8	6	15	1,5	1,3	2	1,2	1	1	7	2	2	0	1	2	1	58	Br+
		16				2,3	1	2	7,10	1	1	-	1	2	1	29	Br+
		17				0			-	0	1	-	2	1	2	32	Br+
		18				2,3	1,5	3	8,10	1	3	-	4	3	1	22	Br+
		19				2,6	1	2	8,10	3	1	0	2	2	2	0	Br+
		20				1	2	2	10	1	1	-	1	1	1	68	Br+
9-10		21	1,6	2,4	3	1,1	2	2	10	0	2	0	2	2	1	11	Br+
		22				3	2.3	6	9,12,12	0	1	-	2	3	2	63	Br+
		23				1	3	2	12	1	2	-	1	1	1	40	Br+
		24				0			-	1	2	-	2	1	1	25	Br+
		25				4	1,8	6	10,11,12	1	2	-	2	3	1	13	Br+
		26				1	1	1	13	0	1	+	2	2	0	46	BO
		27				2,3	3	5	11,14	1	1	-	1	2	1	21	Br+
		28				1	1	1	12	0	1	+	1	1	1	17	Br+
		29				1	1	1	10	2	2	-	1	2	2	24	Br+
		30				1,6	7	8	10	2	1	-	1	3	1	34	0
11-12		31	2,0	3,8	6	2,6	5,5	11	11,11	1	2	0	-	-	-	51	Br+
		32				2,3	1,5	3	11,11	1	2	-	2	2	1	88	Br+
		33				4	2,3	7	11,12,14	0	1	-	1	-	3	37	BO
		34				1	3	2	14	0	2	+	2	3	1	11	Br+
		35				2,3	5,5	10	12,14	1	1	-	2	1	1	16	Br+
		36				1,2	7	7	15+	2	3	0	3	3	1	19	Br+
		37				1	2	2	15+	1	2	+	1	2	1	89	Br+
13-14		38	0,4	1,9	0,5	0			-	0	1	0	1	2	1	43	Br+
		39				1,1	2	2	16	1	1	-	1	2	1	43	Br+
		40				0			-	1	2	+	1	3	1	4	Br+
		41				0			-	1	2	-	1	1	1	17	Br+
		42				0			-	1	2	+	2	3	1	9	Br+
		43				0			-	1	1	-	1	3	1	38	Br+
		44				0			-	1	2	+	2	2	1	20	0
		45				0			-	1	2	-	1	2	0	19	B0
		46				1,1	1	1	14+	1	2	0	2	2	1	64	0
		47				0			-	1	2	-	1	2	1	9	0
		48				1	3	2	16+	1	2	-	1	1	1	14	0
		49				2	1,5	2	14+	0	1	+	4	1	1	19	B0
		50				0			-	0	1	0	2	3	1	15	0
		51				0			-	1	2	-	2	3	1	63	0

Table 1. Diarrhoea (Incidence, Duration, Percentage days ill and age at diarrhoea) in relation to feeding pattern, upper respiratory tract infection, nutritional status, income, hygiene and educational level based on 4,5 months follow up (N= 50 children).

level of income	Percentage days diarrhoea 0	1 - 5	more than 5	total
1	32%	53%	15%	100% (19)
2	33%	37%	29%	100% (21)
3		75%	25%	100% (4)
4.		100%		100% (2)

Table 6. Percentage days diarrhoea in relation to income (N= 46 children, of 4 children no income data were collected).

level of hygiene	Percentage days diarrhoea 0	1 - 5	more than 5	total
1	21%	57%	22%	100%(14)
2	24%	67%	9 %	100% (21)
3	46%	18%	36%	100% (11)

Table 7. Percentage days diarrhoea in relation to Hygiene (N= 46 children, of 4 children no hygiene data were collected).

educational level	Percentage days diarrhoea 0	1 - 5	more than 5	total
1	33%	67%		100% (3)
2	32%	51%	16%	100% (37)
3	14%	43%	43%	100% (7)

Table 8. Percentage days diarrhoea in relation to educational level (N= 47 children, of 3 mothers no education was recorded).

growth	Percentage days symtpomless less than 66%	66 - 84%	more than 84%
above standard	33%	56%	74%
below standard	67%	44%	26%
total	100% (33)	100% (32)	100% (23)

Table 9. Percentage days symptomless in relation to growth (N= 88 children, under 3 years of age).

Cohort age	P diarrh.	diarrh. at age x=+URI	Lowest + highest foodcont. in cohort E	ST	Mean level of food cont. of children with diarrhoea E	ST	Preceding food Cont. E	ST	Preceding Nutr. Status W/A	W/H	Current feeding pattern
2 months (4)	18%	3	2,9 - 4,3	1,6 - 2,8	4,2	2,4	4	1	1	2	Bo
		3					-	-	1	2	"
		3					-	-	1	2	"
		4					-	-	1	2	"
		6					-	-	0	1	"
	1%	2			2,9	1,6	-	-	0	1	Br→Bo
	1%	4*			3,3	1,7	-	-	0	1	Br
	0	-			4.3	2.8	-	-	-	-	-
3 months (3)	9%	3	3,2 - 4,0	1,7 - 3,0	3,7	1,7	-	-	0	0	Bo
		6*					-	-	0	0	"
	16%	4*			3,2	1,7	4	3	0	1	Br
		4*					-	-	0	1	"
	11%	3*			4,0	3,0	-	-	-	-	Bo
		3*					-	-	0	1	"
		4*					-	-	0	0	"
5 months (4)	5%	7*	2,4 - 3,2	2,0 - 2,5	3,2	2,2	-	-	0	0	Br
		8*					-	-	0	0	"
	2%	8*			3,5	2,5	-	-	0	0	Bo/Br
	6%	8*			2,4	2,2	-	-	1	1	Bo
		8*					-	-	1	1	"
	11%	5*			2,6	2,0	3	2	1	0	Br
		6					-	-	1	0	"
		7					-	-	1	0	"
6 months (2)	4%	5	2,5 - 2,8	1,7 - 2,0	2,5	1,7	-	-	0	0	Br
		10					3	1	0	0	"
	5%	6*			2,8	2,0	2	1	0	1	Br
		7					-	-	0	0	"
7 months (3)	1%	7	2,3 - 3,8	1,7 - 3,0	3,8	3,0	-	-	2	2	Br
	2%	10			2,3	1,7	-	-	1	1	Br
	0	-			2,9	1,7	-	-	-	-	"
12 months (4)	2%	14	1,4 - 3,6	1,8 - 2,4	2,4	2,4	-	-	1	2	Br
	10%	12			1,4	1,8	-	-	1	1	Br
		14					-	-	1	1	"
	7%	15*			3,6	2,1	-	-	2	3	Br
	2%	15			2,0	1,8	-	-	1	0	Br
13 months (6)	0	-	2,3 - 3,3	1,9 - 3,1	2,4	1,9	-	-	-	-	Br+
	2%	15			2,3	2,1	-	-	2	2	"
	0	-			2,9	2,5	-	-	-	-	"
	0	-			3,1	3,1	-	-	-	-	"
	0	-			3.3	3,0	-	-	-	-	"
	0	-			2.8	2,2	-	-	-	-	"
14 months (3)	0	-	2,2 - 3,6	1,8 -3,0	2,0	1,2	-	-	-	-	"
	1	14*			3,6	1,5	4	3	1	1	0
	0	-			3,3	2,7	-	-	-	-	"
	2	16*			3,7	2,9	3	3	1	1	0
	2	14*			2,5	1,9	-	-	1	0	BO+
	0	-			2,8	2,9	-	-	-	-	"
	0	-			2.6	1,2	-	-	-	-	"

Table 1 . Diarrhoea (expressed as percentage days of diarrhoea and age at outbreak) in relation to mean level of food contamination, preceding nutritional status, prededing feeding pattern and if diarrhoea occurs within a week after food analysis also preceding food contamination