Diarrhoea Morbidity among Under-five Children: A comparative study of two villages

K. R. Thankappan

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K. R. Thankappan*

1. Introduction

Kerala is reported to have the highest rates of morbidity among the Indian States (NSS, 1980; Visaria, et al, 1996; Sen, 1990; Murray and Chen, 1994; Panikar and Soman, 1984; Soman, et al, 1991; Kannan, et al, 1991). On the other hand mortality and fertility rates in Kerala are much better than in other Indian States and are comparable to those of several developed countries. In Kerala, Infant Mortality Rate was 13/1000 live births and life expectancy at birth was 69 years for males and 73 years for females (SRS, 1993). Soman and Panickar argue that Kerala indeed has a morbidity rate higher than in other Indian States, while Murray, Chen, and Amartya Sen argue that the high morbidity rates observed in Kerala are due to a perception factor. Sen states that the enormously higher literacy rates and the more extensive public health facilities in the State than anywhere else in the country, enable the people of Kerala to perceive illnesses and to attend to them to a much larger extent than that in the rest of India. Murray and Chen reported that the USA has rates of reported morbidity even higher than that of Kerala. Kannan, et al, reported morbidity by socio-economic status in Kerala and argued that Kerala's high morbidity rates are not just a matter of perception but are quite real. They gave two reasons for their conclusion: (i) a large share of morbidity was due to infections which cannot be attributed to the perception factor alone; (ii) poor people reported higher rates of illness episodes than rich people, a finding which goes against the argument that perception factor is the major contributor of the high reported morbidity in the State. In the USA and other developed countries, it is the rich who report more illnesses than the poor.

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The reported morbidity level in Tamil Nadu lies quite close to the Indian average (NSS, 1980; Kannan, et al, 1991). Kerala reported an acute morbidity rate of 71/1000 as compared to 33/1000 of Tamil Nadu. Infant Mortality Rate of Tamil Nadu in 1993 was reported to be 57 per 1000 live births (SRS, 1993). Tamil Nadu and most other States in India have reported higher mortality and lower morbidity rates than those of Kerala.

Diarrhoea is reported to be one of the major causes of morbidity by most of the studies made in Kerala. Kannan, et al, reported that 10 percent of all cases of acute morbidity were due to diarrhoeal diseases. The most important cause for diarrhoea in children under five years of age is infection, mostly from contaminated water and food. No study has looked at the sources of infection in Kerala or Tamil Nadu to find linkages, if any, between water quality, household practices, and diarrhoea among children under the age of five years. A study made by the Socio-Economic Unit of the Health Department of Kerala, Thiruvananthapuram reported that all water samples analysed for bacteriological quality showed contamination (Government of Kerala, 1997) with human excreta. One of the limitations of this study was that samples were collected during the rainy season when contamination of well water is supposed to be the highest. Another limitation is that it analysed quality of well water only (Government of Kerala). The National Family Health Survey (Population Research Centre, 1992) furnished data on morbidity due to diarrhoea among children of four years of age. In Tamil Nadu, 12.7 percent of those children under four years of age were reported to have had diarrhoea in the two weeks prior to the date of survey. For the same period the figure for Kerala (Population Research Centre, Tamil Nadu, 1992) was reported to be 9.2. Though the source of drinking water was reported no information on quality of water or, on the household practices of using water, which might have had an impact on the prevalence of diarrhoea was furnished. It is against this background that a study on the linkages between water quality, household practices, and diarrhoea morbidity among children under five years became essential. Since the water supply system, settlement pattern, and density of population are different in Kerala from things in Tamil Nadu we decided to undertake a pilot study in two villages each in Kerala and Tamil Nadu to find out differences, if any, between these two places in water quality, household practices, and diarrhoea morbidity.

2. Objectives, Methods, and the Study Area

The objective of the study was to focus on a single type of illness in the two regions, namely diarrhoea, among under-five children. Household practices of using drinking water, such as boiling of drinking water before use and hand washing before taking meals, which have a bearing on the incidence of diarrhoea were also monitored. We analysed the water quality of the drinking water sources and tried to link it with diarrhoea morbidity prevalence. We chose diarrhoea since it has been reported as one of the most common illnesses in India (including Kerala), particularly among children under five years of age. Further, the data for analysis could be collected using the services of lay investigators in the case of diarrhoea whereas for other illnesses, only technically qualified persons would be able to collect the information required.

Method

Selection of villages

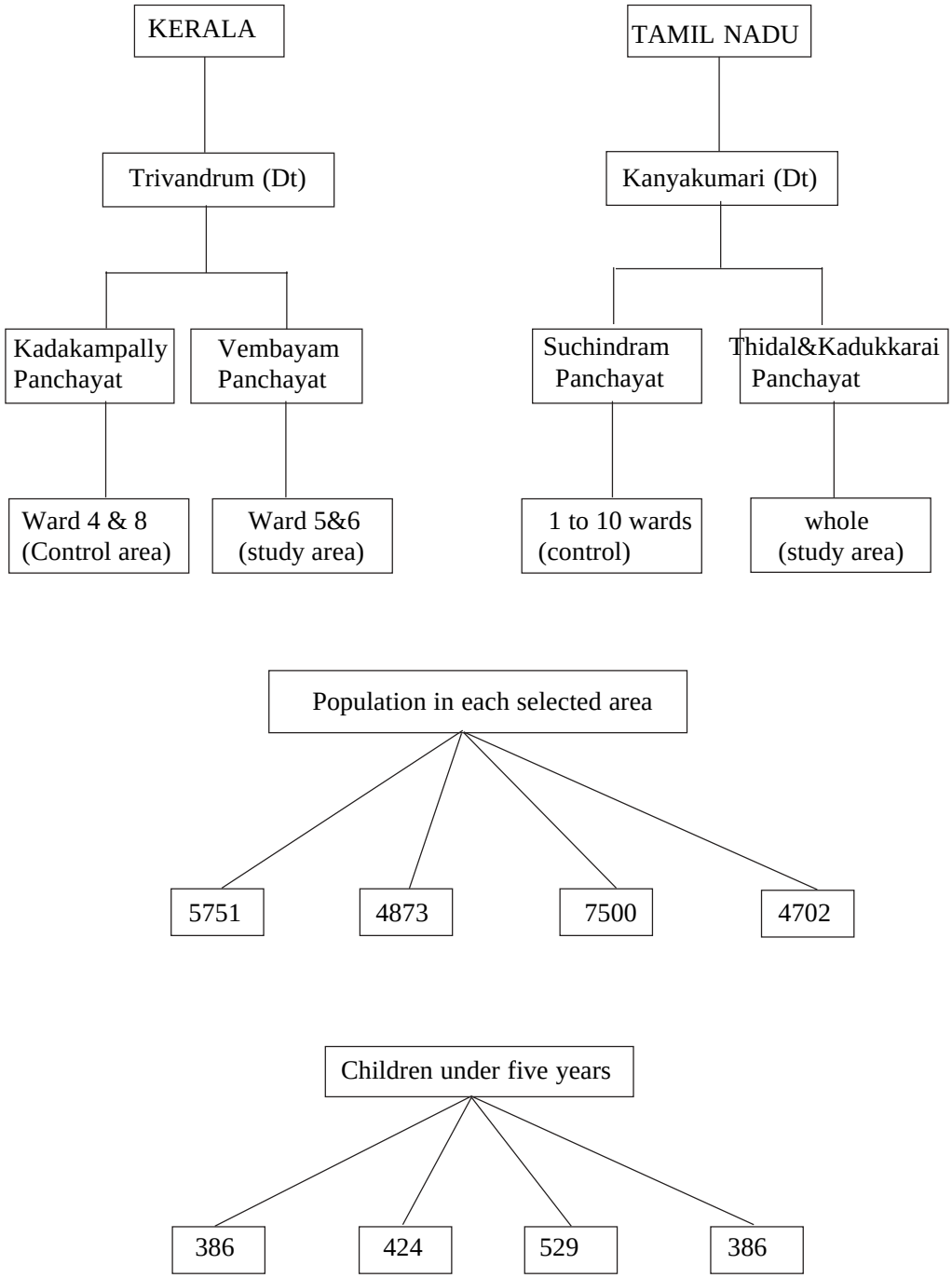
For our study, we decided to have two sites as control and two other sites for detailed inquiry. Locations lying contiguous with urban areas (corporations or municipalities) where the piped water supply is likely to be higher than in other rural areas were selected as the control sites. In these localities the incidence of diarrhoea was expected to be lower than in other rural areas. Wards 4 and 8 of Kadakampally *panchayat* of Thiruvananthapuram district were selected since both these wards were contiguous to and bordering on the Thiruvananthapuram Corporation. Suchindram Town *panchayat* in Kanyakumari district, which bordered on the Nagarcoil Municipality, was selected as the control locality in Tamil Nadu. For selecting the study area we excluded the coastal *panchayats* in both the districts and selected one *panchayat* each randomly from the rest of *panchayats* in the district. We did not want to include coastal *panchayats* in the sampling frame because water supply and sanitation are different in coastal regions than in the midland or highland regions. Vembayam *panchayat* in Thiruvananthapuram district and Thidal village *panchayat* in Kanyakumari district were the localities selected. The schematic diagram depicting the selection process of the areas of study is given below.

Wards 5 and 6 of Vembayam *panchayat*, comprising a population of around 5000, which would contain about 400 children of less than five years of age. Wards 4 and 8 of Kadakampally *panchayat* (which together had a population of more than 5000) were selected for the survey (Census 1991, Kerala). Thidal village *panchayat* (with a population of 2106) and the adjacent Kadukkarai *panchayat* (with a population of 2596) had a population of 4700 (Census 1991, Tamil Nadu). A village *panchayat* in Tamil Nadu is much smaller than its counterpart in Kerala. Since Suchindram *panchayat* had a population of more than 5000 we restricted our study to the first 10 of its 15 wards.

Sample size

Each under-five child in India is expected to have at least two episodes of diarrhoea in a year (Government of India, 1994). Some estimates suggest that the corresponding figure for

Figure 2.1 Schematic diagram of selection of areas for the study



Kerala is lower, only 1.49 in Palakkad and 1.08 episodes in Thiruvananthapuram district, per child per year (Joseph and Raj Mohan, 1996). In Tamil Nadu the prevalence is likely to be higher as suggested by NFHS data. Since we planned to cover six two-week periods for each child, a sample of 400 children under five years of age is expected to give us 400*2*(12/52) or about 185 episodes per village, worked out at the rate of two episodes per child per year. Thus we expected the number of episodes of diarrhoea in a village – during 12 reference weeks of the survey – to vary between, say, 200 and 250. Since our objective was to study how quality of water and household treatment practices combine to produce morbidity, a total of roughly 740 episodes of diarrhoea that we are likely to get for all the four villages taken together, can be considered adequate to do a household cross sectional analysis in which the Kerala-Tamil Nadu contrast could be brought out.

Survey

We did a baseline survey in the selected areas to collect information on all the households and to identify households with at least one under-five child. The detailed household schedule was filled up after interviewing the head of the household (usually the mother of the under-five child). Trained female investigators collected household information like, number of under-five children, household expenditure during the previous month, and housing (e.g., type of house, roof of house, wall of house, floor of house and floor area of the house) using a pre-tested questionnaire. We also collected information on assets such as land and vehicles (e.g., two wheelers, bicycles, and four wheelers). On the basis of this information, households were classified into different socio-economic groups and to examine whether incidence of diarrhoea varied across them. Information on sources of drinking water, sanitation facilities, hygienic practices such as hand-washing before feeding children, cleaning after using toilet and, cleansing bottle before bottle-feeding. Information regarding incidence of diarrhoea during the two weeks prior to the date of survey among the under-five children was also collected, as the main outcome variables. Data on feeding practices, treatment of diarrhoea, expenses incurred for treatment, type of treatment, and the system of treatment were also collected. Subsequently the same households were visited once in every two months so that each of the household in the sample was visited six times during the period of May 1998-April 1999.

Water quality testing

The quality of piped water is expected to be superior to water from other sources. Of course how and whether the household treat water before use is crucial for our purposes. Schematically we may write

Water quality Household practices Morbidity outcomes

We expected variations at the household level, and as between Kerala and Tamil Nadu, in respect of all the factors listed above. Water supply quality was studied by collecting water samples. These samples were collected in all the months of a year to study the seasonal variations in quality. The collected water samples were tested in Thiruvananthapuram.

From each study area 15 samples were collected, making a total of 60 water samples per month. Piped water samples were much fewer, if collected from the same source. For example, in Thiruvananthapuram the source of piped water is Thiruvananthapuram Water Works. Water samples were collected from different places in the selected area and also from public wells and other sources of drinking water. A few samples of water stored after collection from public taps and wells were also taken to find out the impact of storing on water quality. A trained investigator who routinely collected water samples for a Non-Government Organisation (NGO), Centre for Environment and Development, in Thiruvananthapuram collected the samples for the present study. Temperature of the water was noted at the site of water collection while all the other tests were done in the laboratory. Water samples after collection were transported in cold chain containers to avoid death of the organisms in the water during transplantation. During one visit, only 15 samples were collected (from study area). To collect samples from all the four areas we needed a total of four days usually with a break of about one week between the study sites. Water testing was done as per the guidelines of World Health Organisation (World Wide Fund for Nature, India). In addition to the Most Probable Number (MPN), other tests were performed to find out the temperature, PH, turbidity, ammonia content, chloride content, dissolved oxygen, and the number of organisms grown in 24 hours and in 48 hours. The number of colonies grown in the past 24 hours and in 48 hours was also tested.

3. Water Quality, Household Practices, and Socio-economic Factors

Data collected were checked manually and then computerised for data analysis. Water quality analyses were done to find out the bacterial quality of water. If the Most Probable Number (MPN) of bacteria was less than 10 per 100 ml of water, the water sample was considered satisfactory. Other water quality tests were not used for analysis. Bivariate analysis was done to see linkages, if any, between household practices and incidence of morbidity. The variables found significant in bivariate analyses were included in the multivariable logistic regression analysis. We used reported morbidity due to diarrhoea as a dichotomous variable for logistic regression analysis. In these bivariate and multivariate analyses, we used only those children for whom we had information for all the six visits. A p value of < 0.05 was considered significant.

Water quality

Figure 3.1 Proportion of satisfactory water samples in the study area (%) (May 1998 to April 1999)

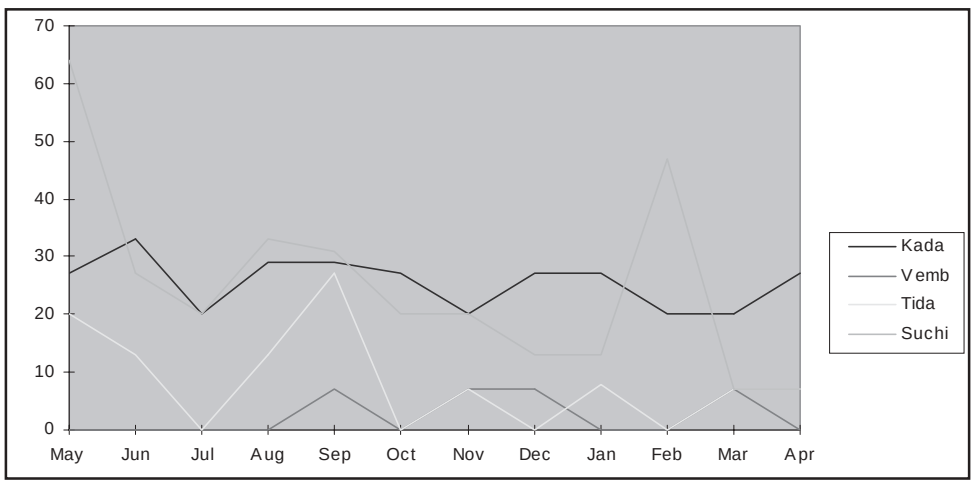


Table 3.1 Percentage of satisfactory water samples in each month (total sample in each area per month is 15)

Area/ month	Ma	Ju	Ju	Au	Sep	Oct	Nov	De	Ja	Feb	Mar	Apr	Total
Kadaka-mpally	27	33	20	29	29	27	20	27	27	20	20	27	24
Vemb-ayam	0	0	0	0	7	0	7	7	0	0	7	0	2
Thidal	20	13	0	13	27	0	7	0	8	7	7	7	8
Suchin-dram	64	27	20	33	31	20	20	13	13	47	7	7	26

Faecal coliform pollution

Various diseases are transmitted by pathogens through water; hence it is important to determine if the drinking water is contaminated with bacteria. But the detection of many pathogens is difficult as they all require different detection tests. Hence, indicator organisms are used to measure bacteriological quality. The indicator species are the group of microbes called coliforms which occur normally in the digestive tract of animals. These bacteria enter rivers through direct releases from animals or from sewage discharged into water. Coliforms are easily detected and occur in large numbers. The presence of coliforms does not prove the presence of pathogens. But, if a large number of coliforms are present, there is a good chance that the water contains disease causing pathogens. It is clear from Table 3.1 that water quality in both the States is unsatisfactory though the control areas of Kadakampally and Suchindram were slightly better than the study areas, as expected.

Table 3.2 Percentage of water samples based on source of water (n=180 in each area)

Name of area	**Well water**				**Tap water**		
	Own well	Public	Stored	Bore	Own	Public	Stored
Kadakampally	74				19	7	
Vembayam	88		6	6			
Thidal*	1	34	30	7	3	7	12
Suchindram					5	1	94

*Thidal —River water—12(6.7)

Water samples were not taken proportional to the source of drinking water because we did not expect much variation in the piped water supply particularly in Kadakampally *panchayat* since the source of piped water was the same for all the sample households. Therefore the overall quality of water source in Kadakampally would be better than what we got from the results of water quality analysis. In Kadakampally *panchayat* nearly three-fourths of the households used piped water quality, which was much higher than that of well water.

Though in all the four *panchayats*, households reported the practice of storing water, this was not the case with Kadakampally *panchayat* in which piped water supply was available on a continuous base in households which had pipe connections. In households in which well water or public tap was the source of drinking water, water used to be stored. No sample was taken from the stored water for analysing water quality in Kadakampally since most households reported that they did not use stored water for drinking. In contrast, in Suchindram *panchayat* people used stored water for drinking. The majority of the samples were therefore taken from stored water.

A total of 180 samples were taken from each area for water analysis. Table 3.2 shows the water quality based on the MPN. Samples with MPN less than 10/100 ml of water are taken as satisfactory. As expected, in both the control areas, the proportion of satisfactory samples was much higher than in the study areas. Even if we count water samples which contained MPN up to 100/100 ml of water as safe drinking water, only 44 percent of the water

samples in Kadakampally and 32 percent in Suchindram were satisfactory. In Suchindram, 40 percent of the samples had incredibly large numbers of MPN.

Seasonal variation

Even in the control areas, water quality varied over seasons, the quality becoming extremely poor in some months. This phenomenon explains the seasonal variations observed in the incidence of diarrhoea morbidity in both the areas under study.

In the Tamil Nadu villages, the number of wells is smaller than in the Kerala villages. In Vembayam for example, the majority of households had own wells. In Tamil Nadu villages, use of public wells was the common practice. Most of the wells in Tamil Nadu had parapets unlike in Kerala.

Source of drinking water for households

Table 3.3 Distribution of households based on source of drinking water

Name of area	Piped water	Well water	Ground water	Surface water	Total
Kadakampally	226 (74)	74 (24)	2 (1)	3 (1)	305
Vembayam	5 (2)	289 (93)	5 (2)	2 (1)	301
Thidal	36 (13)	196 (70)	11 (5)	32 (12)	275
Suchindram	191 (51)	11 (3)	172 (46)	0	374

Figures in brackets shows percentages

As expected, the control areas in both the States had more than 50 percent of households with piped water supply, Kadakampally with 74 percent and Suchindram with 51 percent. In the study areas piped water supply was very low; in Vembayam it was only 2 percent and in Thidal and Kadukkarai it was 13 percent. In Suchindram the next best source was ground water with 46 percent of households depending on that source.

In rural areas of Kerala the majority of households reportedly use well water for drinking purpose. According to the KSSP surveys 1987 (Kannan, et al, 1991) and 1996 (Kunhikannan, et al, 1999) the percentage of households using well water for drinking increased from 60 to 70 percent. In our study Vembayam *panchayat* had higher percentage of households using well water. Kadakampally being very close to Thiruvananthapuram Corporation, the proportion of people using piped water is more than those using well water. In Tamil Nadu, the water supply pattern was completely different from that in Kerala. More public wells and public taps were in use in Tamil Nadu.

Toilet facility for the households

In Kadakampally 94 percent and in Vembayam 83 percent of the households had sanitary latrines while the corresponding percentages in Thidal and Kadukkarai was 11 percent and in Suchindram 57 percent. Sanitation facility is much better in Kerala than in Tamil Nadu.

Figure 3.2 Distribution of household based on toilet facility (Flush toilet)

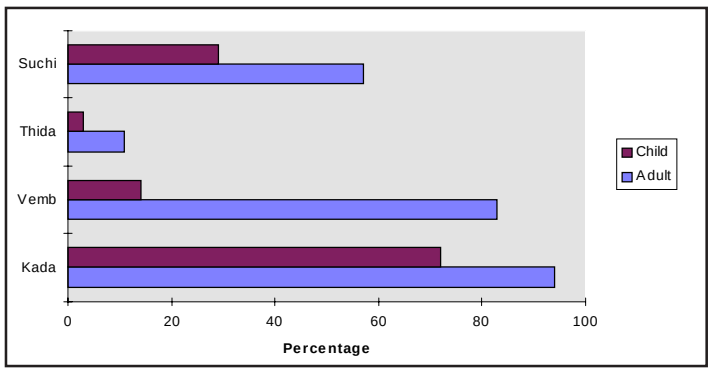


Figure 3.3 Distribution of households based on toilet facility (open air)

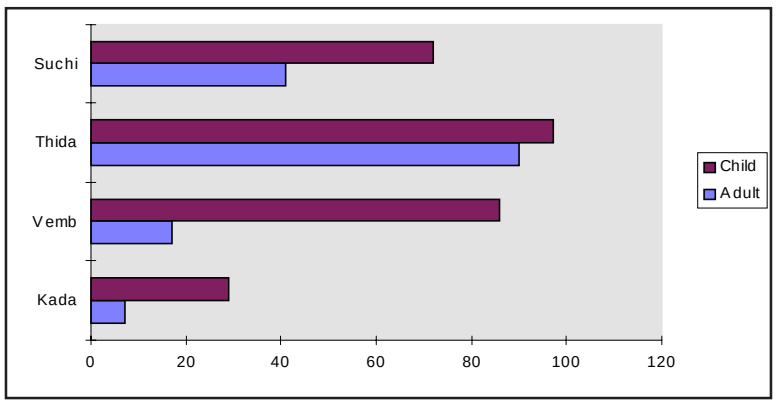


Table 3.4 Distribution of houses based on toilet facility (adults)

Name of area	Flush toilet	Pit Latrine	Open air	Others	Total
Kadakampally	272 (93.8)	3 (1)	20 (6.9)	13	295
Vembayam	253 (83.2)		51 (16.8)	30	307
Thidal	28 (10.6)	1 (0.4)	237 (89.8)	3	270
Suchindram	207 (57.3)	6 (1.7)	147 (40.7)	40	375

This is an important factor which might influence the incidence of diarrhoea. In both the States control areas have more sanitary latrines than study areas. The distance between water source and toilet facility is also an important factor in the contamination of water with human excreta. This distance is likely to be more in the study areas since they had more land area per household than in the control area where the land holding was smaller.

Toilet facility for children was surprisingly low in all the areas. In Kadakampally, toilet facilities were available for adults in 94 percent of the households; but for children, it was available for only 72 percent; the respective figures were 83 percent and 14 percent. For the Tamil Nadu villages, the figures were smaller still; 11 percent and 3 percent in Thidal and 57 percent and 29 percent in Suchindram. This is an important issue which needs attention

Table 3.5 Distribution of household based on toilet facilities for children

Name of area	Own flush toilet	Pit latrine	Open air
Kadakampally	205 (71.9)	-	85 (29.3)
Vembayam	44 (14.4)	-	262 (85.6)
Thidal	9 (3.4)	-	254 (96.6)
Suchindram	106 (28.6)	3 (0.8)	268 (72.2)

of policy makers and health care providers. This is probably due to a common belief that children's faeces do not pose any health hazard and they do not contain bacteria. In fact, children's faeces are likely to contain more bacteria and other infectious agents than faeces of adults. Children have more parasitic infections than adults have. Therefore, it is important to highlight this aspect of sanitation in health programmes.

Household practices related to water

Table 3.6 Distribution of households based on practices of storing water

Area	Store water No (%)	Where do you store water				
		Pot	Vessel	Drum	Tank	Other
Kadakampally	285(98.3)	247(86.7)	26 (9.1)	8 (2.80)	3 (1.1)	1 (0.4)
Vembayam	301(98)	144(47.5)	49(16.2)	110(36.3)		
Thidal	268(99.6)	171(63.8)	5 (1.9)	92(34.3)		
Suchindram	373(99.5)	40(10.7)	5 (1.3)	329 (88)		

It is commonly believed that when water is stored, its quality decreases. On the contrary, in our study we found that when water was stored, the quality did not deteriorate. In all the areas except Suchindram adults took water from the store. When children take water the chances of contamination are more. The contamination which takes place while taking water from store will not be captured in our study since we took the water samples from the store and not from water taken out by a child or by an adult from the store.

Table 3.7 Distribution of households based on practices related to storage of water

Area	Containers used to take water from store				Who takes water from the store	
	Mug	Coconut shell	Others	Child	Adults	Both
Kadakampally	265(92.3)	22(7.7)		4(1.5)	270(98.5)	
Vembayam	287(95.3)	5(1.7)	9(3)	4(1.3)	299(98.4)	1(0.3)
Thidal	236(88.4)	28(10.5)	3(1.1)	6(2.2)	256(95.9)	5(1.9)
Suchindram	326(87.4)	44(11.8)	3(0.8)	247(65.9)	127(33.9)	1(0.3)

Figuret 3.4 Distribution of households based on the practice of heating water for drinking purposes

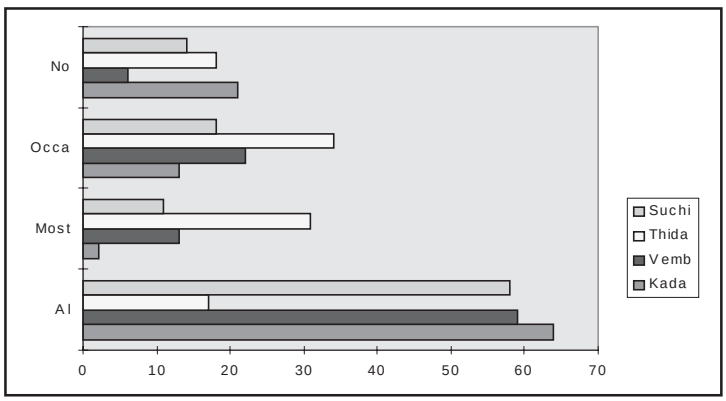


Table 3.8 Distribution of households heating water for drinking purposes (# and %)

Area	Always	Mostly	Occasionally	Not at all
Kadakampally	183(63.8)	7(2.4)	36(12.5)	61(21.3)
Vembayam	182(59.3)	39(12.7)	68(22.1)	18(5.9)
Thidal	43(16.9)	79(31.0)	87(34.1)	46(18.0)
Suchindram	216(57.6)	42(11.2)	66(17.60	51(13.6)

Figure 3.5 Distribution of households based on the practice of boiling water for drinking purposes

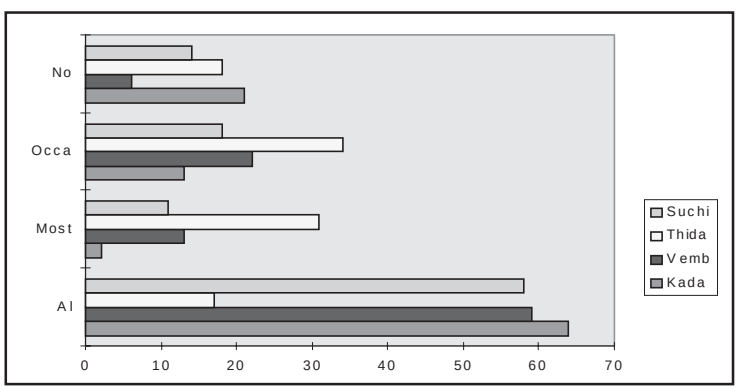


Table 3.9 Distribution of households boiling water for drinking purposes

Area	Always	Mostly	Occasionally	Not at all
Kadakampally	175(62.1)	11(3.9)	37(13.1)	59(20.9)
Vembayam	194(64.5)	24(8.0)	69(22.9)	14(4.7)
Thidal	59(27.8)	90(42.5)	44(20.8)	19(9.0)
Suchindram	194(52.0)	54(14.5)	92(24.7)	33(8.8)

Practice of heating and boiling water for drinking purposes was more common in the Kerala villages than in the Tamil Nadu. In Tamil Nadu itself, there were inter-local differences; people in Suchindram used boiling water for drinking more often than people in Thidal did. This practice can prevent the occurrence of diarrhoea even if the water contains micro organisms. Even if water is boiled only for less than five minutes, most of the micro-organism causing diarrhoea is likely to be killed.

Table 3.10 Duration of boiling water for drinking

Name of area	< 5 minutes	5-10 minutes	> 10 minutes	others
Kadakampally	43(19.0)	158(69.9)	21(9.3)	4(1.8)
Vembayam	285(96.9)	3(1.0)	5(1.7)	1(0.3)
Thidal	125(55.8)	93(41.5)	5(2.2)	1(0.4)
Suchindram	68(18.4)	148(40.1)	151(40.9)	2(0.5)

The majority of the respondents reported that they boiled water for less than 10 minutes.

Household practices related to child rearing

Figure 3.6 Mean age of weaning

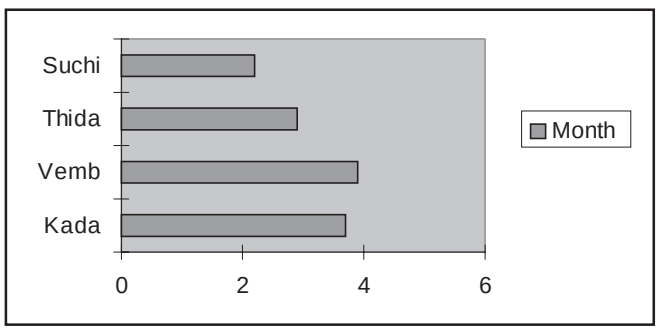


Table 3.11 Distribution of households based on introduction of artificial feeding

Name of area	Bottle feed (Yes)	Mean age of initiation (months)	Mean number of bottles	Wash bottle after each feeding	Don't wash after each feeding
Kadakampally	175(97.2)	3.7	1.28	172(98.9)	2(1.1)
Vembayam	120(47.6)	3.9	1.35	62(98.4)	1(1.6)
Thidal	129(56.3)	2.9	1.04	130(100)	
Suchindram	260(79.8)	2.2	1.09	260(99.6)	1(0.4)

The ideal age of weaning an infant from breast-feeding is five to six months. In all the areas the average age of weaning was found to be less than four months. This practice could lead to early occurrence of diarrhoea. In both the areas of Tamil Nadu, weaning was made before the infant became three months old. In the matter of bottle-feeding, Kadakampally

tops the list with over 97 percent of the children getting bottle-fed. This practice is comparatively low in Vembayam (in Kerala) and Thidal (Tamil Nadu).

Table 3.11 Distribution of households based on type of feed

Area	Cow's milk	Powder	Glucose water	Goat milk
Kadakampally	82(47.7)	90(52.3)		
Vembayam	55(88.7)	5(8.1)	1(1.6)	1(1.6)
Thidal	126(98.4)	2(1.6)		
Suchindram	256(99.2)	2(0.8)		

Except in Kadakampally in all the areas cow's milk was used for feeding infants. In Kadakampally, more than one-half of the mothers used milk powder as the baby food.

Table 3.12 Distribution of households by persons (other than mothers) who keep the child clean

Area	Father	Grandmother	Sister	Younger	Elder	Others
Kadakampally	5(10.4)	31(64.6)	6(12.5)	4(8.3)	1(2.1)	1(2.1)
Vembayam	70(23.0)	207(67.9)	24(7.9)	4(1.3)		
Thidal	2(2.2)	82(90.1)	6(6.6)	1(1.1)		
Suchindram	8(6.6)	105(86.1)	9(7.4)			

In all the areas, grandmothers were reported to be taking an important role in childcare; they were involved in keeping the child clean and feeding the child apart from mothers. This factor has to be considered by health educators and other health care providers of child care. The usual practice of targeting exclusively mothers of under-five children for health education programmes such as mothers' meetings organised by the health services department, may not have the desired impact on the healthcare practices of the households. Special efforts should be taken to mobilise grandmothers to such health education programmes.

Table 3.13 Distribution of households by persons (other than mothers) who feed the child

Area	Father	Grandmother	Sister	Younger	Others
Kadakampally	10(13.3)	54(72.0)	6(8)	4(5.3)	1(1.3)
Vembayam	69(22.6)	212(69.5)	21(6.9)	3(1.0)	
Thidal		96(98.0)	2(2.0)		
Suchindram	7(5.9)	102(86.4)	9(7.6)		

In the feeding of the child, grandmothers have a great role. In Tamil Nadu the role of father in feeding the child was reported to be lower than in Kerala.

Table 3.14 Distribution of households by persons (other than mothers) who carry the child

Area	Father	Grandmother	Sister	Younger	Others
Kadakampally	38(35.2)	58(53.7)	8 (7.4)	2(1.9)	1(0.9)
Vembayam	78(25.5)	191(62.4)	35(11.4)	2(0.7)	
Thidal	18(12.4)	100(69.0)	26(17.9)	1(0.7)	
Suchindram	7(0.6)	102(87.2)	8(6.8)		

Table 3.15 Distribution of households by persons (other than mothers) who attend to the child's toilet

Area	Grandmother	Father	Child him/herself	Others
Kadakampally	16(30.8)	34(65.4)	1(1.9)	1(1.9)
Vembayam	68(22.4)	208(68.4)	26(8.6)	2(0.7)
Thidal	3(3.1)	95(96.9)		
Suchindram	6(5.2)	101(87.1)	9(7.8)	

Mothers usually do cleaning the child after defecation. However, the role of fathers here is more frequently reported from both the States.

Table 3.16 Distribution of households by toilet practice for children

Area	Soap & Water	water only
Kadakampally	253(87.2)	37 (12.8)
Vembayam	71(23.2)	235 (76.8)
Thidal	--------	259 (100)
Suchindram	34(9.1)	340 (90.4)

The role of soap in the toilet of children is reported from Kadakampally in 87 percent of the cases. In other *panchayats*, only water was predominantly in use for cleaning the child after defecation.

Table 3.17 Distribution of households using running water/stored water for cleaning after defecation (children)

Area	Running water	Stored water
Kadakampally	10(3.6)	271 (96.4)
Vembayam	4(1.3)	301 (98.7)
Thidal		262 (100)
Suchindram	5(1.3)	368 (98.7)

This information was collected because we thought that if people use stored water they might not use sufficient water for cleaning. In Thidal, all mothers reported that they used

stored water for cleaning the child after defecation. In most practices, Thidal was found to be lagging behind other areas in health care-related household practices.

Table 3.18 Distribution of households using running water/stored water for toilet by adults

Area	Running water	Stored water
Kadakampally	14 (5.0)	264(95)
Vembayam	7 (2.3)	291(97.7)
Thidal		263(100)
Suchindram	3(0.8)	371(99.2)

Table 3.19 Distribution of households by toilet practice for adults

Area	Soap & Water	water only
Kadakampally	247(85.2)	43 (14.8)
Vembayam	16(5.2)	289 (94.8)
Thidal	--------	265 (100)
Suchindram	37(9.9)	338 (90.2)

Table 3.20 Distribution of households based on the practice of washing hands before eating

Area	Always do	Mostly	Occasionally	Not at all
Kadakampally	285(99.3)	1 (0.3)	1 (0.3)	
Vembayam	298(97.4)	5 (1.6)	3 (1.0)	
Thidal		6 (2.3)	238 (92.2)	14 (5.4)
Suchindram	299(80.2)	18 (4.8)	11 (2.9)	44 (11.8)

Some of the important variables which we were interested in were the household practices which might influence the outcome variable, diarrhoea morbidity. The practice of washing hands before taking food has been reported in several studies to reduce the incidence of diarrhoea. This habit was seen to be much better in both study and control villages of Kerala than in the Tamil Nadu villages. It is surprising to note that in Thidal and Kadukkarai, the vast majority (92 percent) of the respondents wash their hands only occasionally before taking meals. Nobody reported that they inevitably wash their hands before meals. In all the other areas the majority of the households reported that they always wash their hands before meals.

Figure 3.7 Distribution of households based on practice of cleaning hands before snacks

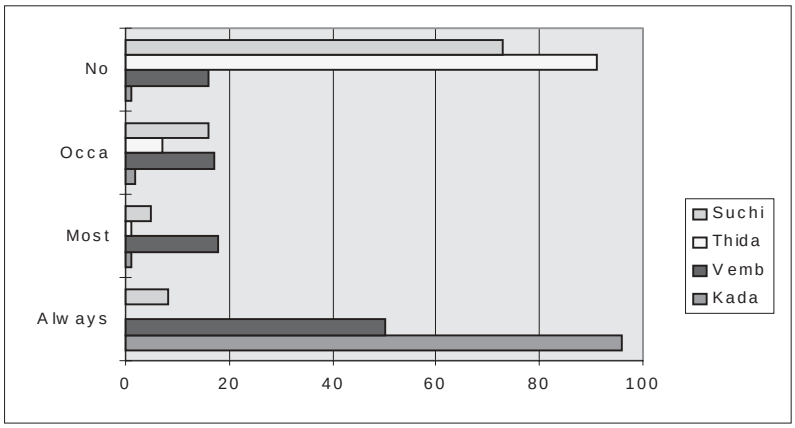


Table 3.21 Distribution of households based on the practice of cleaning hands before snacks

Area	Always do	Mostly	Occasionally	Not at all
Kadakampally	276(95.8)	4(1.4)	6(2.1)	2(0.7)
Vembayam	152(49.7)	54(17.6)	51(16.7)	49(16.0)
Thidal	1 (0.4)	3(1.2)	18(7.0)	235(91.4)
Suchindram	29(7.8)	18(4.8)	54(14.5)	272(72.9)

Figuret 3.8 Distribution of households based on the practice of cleaning hands before feeding the child

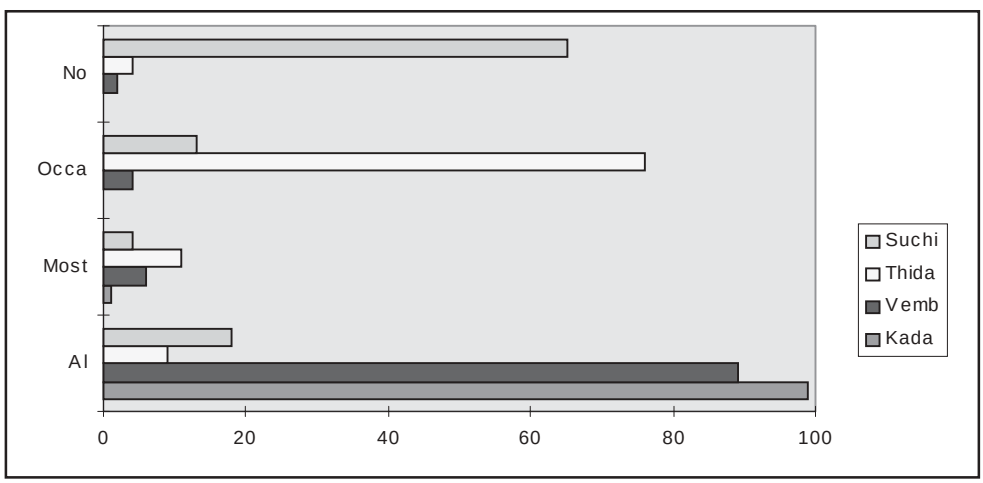


Table 3.22 Distribution of households based on the practice of cleaning hands before feeding child

Area	Always	Mostly	Occasionally	Not at all
Kadakampally	284(99.0)	2(0.7)	1(0.3)	
Vembayam	271(89.1)	17(5.6)	11(3.6)	5(1.6)
Thidal	23(8.9)	28(10.9)	195(75.9)	11(4.3)
Suchindram	67(17.9)	15(4.0)	48(12.8)	244(65.2)

Figure 3.9 Distribution of households based on the practice of cleaning hands before feeding snacks to the child

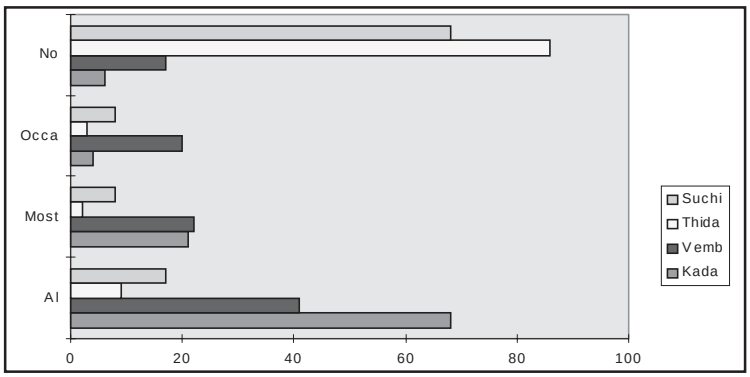


Table 3.23 Distribution of households based on the practice of washing hands before feeding snacks to the child

Area	Always	Mostly	Occasionally	Not at all
Kadakampally	190(68.3)	59(21.2)	12(4.3)	17(6.1)
Vembayam	126(41.2)	66(21.6)	62(20.3)	52(17.0)
Thidal	23(9.0)	6(2.3)	8(3.1)	219(85.5)
Suchindram	63(16.9)	28(7.5)	29(7.8)	253(67.8)

Figure 3.9 Distribution of households based on practice of eating food not prepared in home

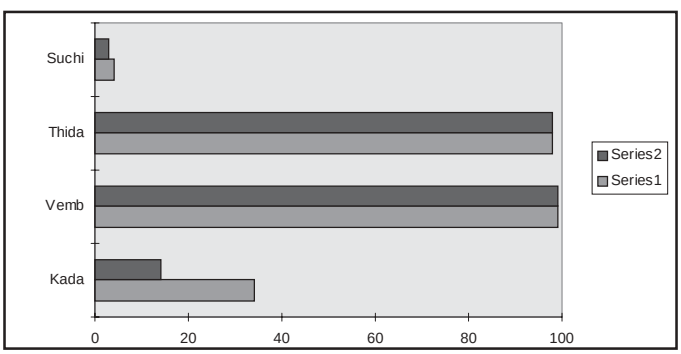


Table 3.24 Distribution of households reporting eating food not prepared at home

Area	Children	Adults
Kadakampally	97(33.6)	40(13.9)
Vembayam	301(99.0)	304(99.3)
Thidal	254(98.4)	252(98.1)
Suchindram	16(4.3)	11(3.0)

Socio-economic variables of households

Table 3.25 Distribution of households by size of landholding

Name of area	Land in cents(mean)
Kadakampally	7.38
Vembayam	27.33
Thidal	96.37
Suchindram	2.78

Table 3.26 Distribution of households by average monthly expenditure

Area	Food expense	School fee	Other expenses	Total expenses
Kadakampally	1251	130	257	1990
Vembayam	1395	89	427	1831
Thidal	937	191	525	1488
Suchindram	1019	127	373	1180

The average monthly household expenditure in the selected areas (both study areas and control areas) did not differ much across the villages except that in Kerala expenses were slightly higher than in Tamil Nadu.

Table 3.27 Ownership of houses [No. (percent in brackets)]

Area	Own house	Rented houses	Other types
Kadakampally	233(79.8)	57(19.5)	2(0.7)
Vembayam	286(93.2)	13(4.2)	8(2.6)
Thidal	235(89.7)	26(9.9)	1(0.4)
Suchindram	252(68.1)	112(30.3)	6(1.6)

With regard to the ownership of houses, the control areas had more rented houses than the study areas had probably because the former were closer to urban areas. Tamil Nadu villages had higher percentages of rented houses than Kerala villages had.

Table 3.28 Distribution of houses by number of rooms

Area	1 room	2 rooms	3 rooms	> 3 rooms
Kadakampally	32(11.0)	80(27.5)	88(30.2)	91(31.1)
Vembayam	8(2.6)	89(29.2)	126(41.3)	82(26.8)
Thidal	21(9.2)	87(38.0)	82(35.8)	39(17.1)
Suchindram	77(21.2.)	53(14.6)	82(22,6)	151(41.7)

Table 3.29 Distribution of houses by type of roof

Name of area	Grass/leaves	Sheet	Tiles	Concrete
Kadakampally	70(24.2)	15(5.2)	104(36)	100(34.6)
Vembayam	130(42.3)	30(9.8)	93(30.3)	54(17.6)
Thidal	63(23.9)	16(6.1)	117(44.3)	68(25.8)
Suchindram	49(13.2)	23(6.2)	188(50.7)	111(29.9)

Table 3.30 Distribution of houses by type of wall

Area	Grass/*panambu*	Mud	Wood/sheet	Bricks/stones
Kadakampally	6(2.2)	41(14.7)	5(1.8)	227(81.4)
Vembayam	19(6.2)	142(46.4)	2(0.7)	143(46.7)
Thidal	16(6.)	73(27.5)	4(1.5)	172(64.9)
Suchindram	24(6.5)	101(27.2)	5(1.3)	241(64.8)

Table 3.31 Distribution of houses by type of floor

Area	Mud	Cement	Mosaic	Marble/ceramic
Kadakampally	23(8)	209(72.6)	55(19.1)	1(0.3)
Vembayam	165(54.1)	130(42.6)	9(3)	1(0.3)
Thidal	117(44.2)	140(52.8)	4(1.5)	4(1.5)
Suchindram	111(29.9)	241(65)	13(3.5)	6(1.6)

Table 3.32 Distribution of houses by floor area

Area	<500 sq.ft	501-1000	1001-2000	> 2000
Kadakampally	19(6.6)	114(39.3)	144(49.7)	13(4.5)
Vembayam	239(78.4)	62(20.3)	4(1.3)	0(0)
Thidal	126(48.1)	118(45.0)	15(5.7)	3(1.1)
Suchindram	241(64.8)	128(34.4)	0(0)	3(0.8)

Households in both the study areas in Tamil Nadu and Kerala had very few vehicles compared to households in control areas. Overall, Kerala villages had more vehicles than Tamil Nadu villages. Utilisation of health services would be higher if there are more vehicles. This could be also a reflection of motorable roads in the villages.

Table 3.33 Distribution of households by ownership of vehicles

Area	Bicycle	Scooter/ Motor cycle	Four wheeler	No vehicle
Kadakampally	80 (27.4)	64 (21.8)	10 (3.4)	138 (47.4)
Vembayam	6 (2)	6 (2)	4 (1.3)	285 (94.7)
Thidal	1 (0.4)	0 (0)	0	263 (99.6)
Suchindram	40 (10.4)	30 (8)	13 (3.5)	296 (78.1)

4. Diarrhoea: Incidence, Management, and Linkages

Though awareness of diarrhoea and the management of diarrhoea were not included in the objectives of the study we decided to include them considering their importance in reducing morbidity and mortality due to diarrhoea. Nearly 100 percent of the mothers had heard of diarrhoea in all the villages and barring a few individuals, all respondents correctly understood diarrhoea as loose motion. However, regarding the causes of acute diarrhoea there was a mixed response (Table 4.1).

Table 4.1 Distribution of households by causes reported for diarrhoea

Area	Infection	Indige-stion	Change in water	Change in food	Eating unclean food	Drin-king bad water	Change in climate	Others
Kadaka-mpally	10(4)	5(2)	2(0.7)	2(0.7)	265(93)	1(0.4)		
Vemb-ayam	122(41)	35(12)	3(1)	24(8)	54(18)	35(11.7)	6(2.0)	19(6)
Thidal	31(12)	168(63)	8(3)	47(18)		1(0.4)	10(3.8)	
Suchin-dram	13(4)	3(1)	27(7)	56(15)	10(3)	28(7.5)	235(63)	3(1)

The correct response one would expect is 'infection', which was mentioned by only a small proportion of the respondents. However, 'drinking bad water' and 'eating unclean food' also could be taken as appropriate answers. Just over 40 percent of the respondents in Vembayam mentioned infection as the cause of diarrhoea while in other areas the proportions ranged from 3.5 percent to 11.7 percent. Surprisingly, the majority of respondents did not mention drinking bad water as a cause for diarrhoea. Even in Kadakampally supposed to have a high level of awareness only one person gave this answer as the cause. People in general do not seem to have any firm idea about the cause of diarrhoea. This is an important issue, which needs further exploration.

Ninety percent of respondents in Suchindram said that they would seek immediate care once a child develops diarrhoea. Since 90 percent of acute diarrhoea can be managed at home itself with fluids and food, the message of home management of diarrhoea probably has not reached these villages. When vomiting along with diarrhoea was observed in a person, most people thought it serious enough to seek health care from professional sources.

The period of the year from June to August is the season south-west monsoon rains in both Kerala and the Kanyakumari district of Tamil Nadu. Diarrhoea morbidity was reported to be the maximum during this season in all the four study centres. As expected, Kadakampally and Suchindram village *panchayats* (control villages) reported much lower diarrhoea episodes than in the study areas of Vembayam in Kerala and Thidal in Tamil Nadu. When the average prevalence rates in the study area in Kerala and Tamil Nadu villages were compared, it was

Table 4.2 Distribution of households seeking treatment for diarrhoea

Area	Immed-iately	After few hours	After a day	Diarrhoea +some other illness	Blood in stools	Will not seek care	Others
Kadaka-mpally	9(12.0)	16(21.3)	36(48.0)	3 (4.0)	2 (2.7)	8(10.7)	1 (1.3)
Vemb-ayam	12(5.0)	116(48.5)	32(13.4)	1 (0.4)		12(5.0)	66 (28)
Thidal	11(4.2)	177(66.8)	74(27.9)	2 (0.8)		1 (0.4)	
Suchin-dram	342(90.7)	9(2.4)	19 (5.0)	5 (1.3)		1 (0.3)	1 (0.3)

Morbidity due to diarrhoea

Table 4.3 Distribution of children affected by diarrhoea according to age (months)

Name of area	<3	3-6	6-12	12-24	24-36	36-48	48-60	Total
Kadaka-mpally	19 (5.0)	29(7.7)	34(9.0)	88(23.2)	85(22.4)	70(18.5)	54(14.2)	379
Vemb-ayam	15 (3.8)	19(4.8)	46(11.5)	84(21.0)	85(21.3)	77(19.3)	74(18.5)	400
Thidal	16 (4.5)	12(3.4)	42(11.8)	59(16.5)	59(16.5)	74(20.7)	95(26.6)	357
Suchin-dram	15 (2.9)	34(6.6)	43(8.4)	99(19.3)	93(18.2)	87(17.0)	141(27.5)	512

Table 4.4 Prevalence of diarrhoea in the four study areas

Study area	Total No. of children	Number of children reported diarrhoea (%)	P Value
Comparison between the study areas in Kerala and Tamil Nadu			
Vembayam	160	39(24.4)	0.041
Tidal	279	95(34.1)	
Comparison between the study and the control areas in Kerala			
Kadakampally	94	13(14)	0.054
Vembayam	160	39(24.4)	
Comparison between the study and the control areas in Tamil Nadu			
Thidal	279	95(34.1)	<0.001
Suchindram	370	47(12.7)	
Comparison between the control areas in Kerala and Tamil Nadu			
Kadakampally	94	13(14)	0.731
Suchindram	370	47(12.7)	

found to be significantly higher in Tamil Nadu village (p=0.041). This prevalence rate was calculated based on the data during six repeated visits. Only those children for whom we had collected information in all the six visits are included in this analysis. The rate is, therefore for a total period of 12 weeks (2*6). If a particular child reported diarrhoea in any of these visits it was considered a positive response for diarrhoea morbidity. Diarrhoea morbidity was considered a dichotomous variable in this analysis. If a child had more than one episode of diarrhoea in the six visits, that information would not be captured in this analysis. We also compared the study and the control areas in both the States. In Tamil Nadu significant difference (p<0.001) was observed in diarrhoea prevalence as between the study area (Thidal) and the control area (Suchindram). However, the difference as between the study and the control areas in Kerala did not reach the level of statistical significance (p>0.05). This could be one reason why the overall diarrhoea prevalence in Tamil Nadu villages was found to be higher. There was hardly any difference as between the control areas in Tamil Nadu and Kerala (p>0.05).

Episodes of Diarrhoea

We collected information on diarrhoea for a period of 12 weeks of a year. From this information we calculated the average number of episodes of diarrhoea per child per year (Table 4.5). The mean episodes per child per year were 1.1, which was much lower than the figures of 2-3 episodes per child per year reported for India as a whole. Thidal in Tamil Nadu had the highest number of episodes of diarrhoea per child per year (1.9) followed by the study area in Kerala, Vembayam *panchayat* (1.2). Compared to the control areas in both States, the study area had higher number of episodes of diarrhoea per child per year. The difference in the number of episodes between the study area was statistically significant (p=0.012). The mean number of episodes of diarrhoea per child per year was 0.65 in

Table 4.5 Mean number of episodes of diarrhoea reported per child per year

Study Area	Total number of children	Mean Number of episodes of diarrhea	P Value
Comparison between the study areas in Kerala and Tamil Nadu			
Vembayam	160	1.2	0.012
Thidal	279	1.9	
Comparison between the study and the control areas in Kerala			
Kadakampally	94	0.65	0.044
Vembayam	160	1.2	
Comparison between the study and the control areas in Tamil Nadu			
Thidal	279	1.9	<0.001
Suchindram	370	0.60	
Comparison between the control areas in Kerala and Tamil Nadu			
Kadakampally	94	0.65	0.730
Suchindram	370	0.60	

Kadakampally and 0.60 in Suchindram; this difference was not, however, significant. On the other hand, the difference between Kadakampally and Vembayam was found significant (p=0.044). The difference as between Thidal and Suchindram was highly significant (p<0.001).

Figure 4.1 Seasonal variation of diarrhoea prevalence in two weeks recall period

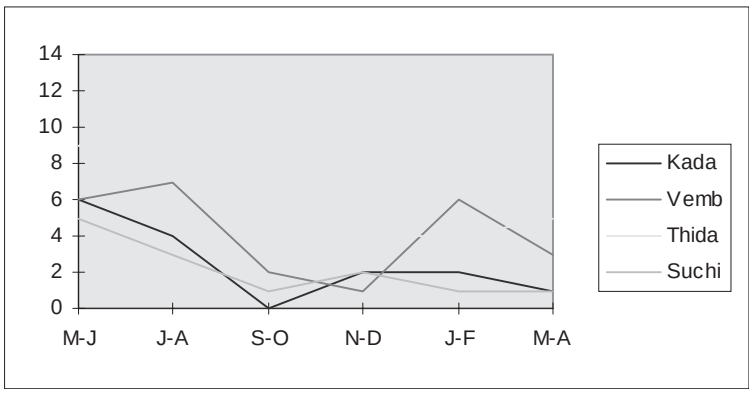


Table 4.6 and Figure 4.1 show the seasonal variation in the prevalence of diarrhoea in the study areas. The maximum number of children reported diarrhoea during the rainy season in July and August. This is what was expected also. After the rainy season the prevalence rate gradually came down in all the areas except Vembayam where another peak was observed in January-February. This could be due to the scarcity of water in that village during this period. Most of the wells are dried during this period and people use alternate, unhygienic sources of water.

Table 4.6 Seasonal variation of diarrhoea prevalence in the study areas: No. of children visited (% reported diarrhoea) during the six visits

Name of Area	May-June	July-Aug	Sept-Oct	Nov-Dec	Jan-Feb	Mar-April
Kadakampally	377(6.4)	287(3.5)	333(0.3)	260(1.5)	243(1.6)	201(1.0)
Vembayam	402(6.2)	361(6.9)	354(2.3)	250(1.3)	250(5.6)	302(2.6)
Thidal	330(9.1)	335(12.8)	373(8.5)	350(4.0)	337(3.6)	352(4.5)
Suchindram	509(4.9)	436(3.2)	452(1.9)	478(0.6)	478(0.6)	451(0.9)

Table 4.7 Duration of breast feeding (in months)

Area	< 3	3-6	6- 9	9-12	> 1 2	Total
Kadakampally	42(11.1)	40(10.5)	50(13.2)	14(3.7)	234(61.6)	380
Vembayam	18(4.5)	31(7.7)	36(9.0)	29(7.2)	288(71.6)	402
Thidal	20(5.6)	16(4.5)	27(7.6)	23(6.4)	271(75.9)	357
Suchindram	43(8.8)	80(16.4)	65(13.3)	27(5.5)	273(55.9)	488

More than 50 percent of the mothers reported that they breast-feed their infants for more than a year. We did not collect information on exclusive breast-feeding. Only a small proportion of mothers stopped breast-feeding before the infant was three months' old. It has been reported by various researchers that incidence of diarrhoea in breast-fed children is lower compared to incidence in non-breast-fed children.

Table 4.8 Age of children at weaning (in months)

Area	< 3	3-6	6- 9	9-12	> 1 2	Total
Kadakampally	42(11.1)	40(10.5)	50(13.2)	14(3.7)	234(61.6)	380
Vembayam	18(4.5)	31(7.7)	36(9.0)	29(7.2)	288(71.6)	402
Thidal	20(5.6)	16(4.5)	27(7.6)	23(6.4)	271(75.9)	357
Suchindram	43(8.8)	80(16.4)	65(13.3)	27(5.5)	273(55.9)	488

Age at weaning is a factor which might influence the incidence of diarrhoea. Neither early weaning nor late weaning is good for children. Around 5-6 months of age is considered the best time for weaning. About 25 of the children in our sample were weaned before the age of four months and around 50 percent of the children were weaned after six months. This is an issue which needs educational inputs in all the study areas.

Table 4.9 Distribution of children receiving Vitamin A supplementation

Area	Yes	No	No. of doses
Kadakampally	348(91.6)	32(8.4)	2.55
Vembayam	310(78.5)	85(21.5)	2.44
Thidal	277(77.8)	79(22.2)	1.85
Suchindram	502(98.2)	9(1.8)	2.14

Vitamin A supplementation is expected to reduce the incidence of diarrhoea in children in addition to other benefits of this vitamin. Vast majority of the children studied were given Vitamin A supplementation (over 90 percent) in both the control areas.

Table 4.10 Distribution of children receiving Measles immunisation

Area	Yes	No	Age of immunisation in months			
			< 9	9-12	12-15	> 1 5
Kadakampally	302(79.5)	78(20.5)		282(93.4)	2(0.7)	18(6.0)
Vembayam	323(82.6)	68(17.4)	3(0.9)	301(93.2)	10(3.1)	9(2.8)
Thidal	298(83.9)	57(16.1)		297(99.7)		1(0.3)
Suchindram	498(97.3)	14(2.7)	446(89.9)	17(3.4)	2(0.4)	31(6.3)

Linkage between measles immunisation and incidence of diarrhoea is observed. Children who catch measles are more likely to get diarrhoea also. Measles immunisation coverage in all the area was fairly high. However, Kadakampally village *panchayat* in Kerala reported the lowest measles immunisation coverage, which was not expected.

Management of diarrhoea

Table 4.11 Distribution of children receiving fluid management during diarrhoea

Name of area	Offered fluid		If yes		
	Yes	No	Same	More	Less
Kadakampally	20(90.9)	2(9.1)		20(90.7)	2(9.1)
Vembayam	23(100)		12(52.2)	11(47.8)	
Thidal	29(100)		25(92.6)		2(7.4)
Suchindram	2(16.7)	10(83.3)	2(100)		

Management of diarrhoea is revolutionised after the invention of Oral Rehydration Therapy (ORS). The main management principles of diarrhoea are replacement of fluid and food and watching for signs of dehydration. Offering fluid when the child develops diarrhoea is important. In our sample in both the study areas 100 percent of mothers offered fluid. About 10 percent of mothers in the control areas, both in Kerala and Tamil Nadu, did not, however, do so.

Regarding treatment of diarrhoea the majority of people in Kerala and the entire population in Suchindram resorted to allopathy for treatment while in Thidal nearly everybody used other systems possibly the traditional indigenous practices. In Kadakampally, 95 percent of diarrhoea cases were treated as inpatients. In other areas inpatient treatment ranged from 0 to 6 percent. In both the study areas in Kerala and in Tamil Nadu, most diarrhoea patients were given tablets, syrup or an injection, treatments not usually needed in the management of acute diarrhoea. In Suchindram only about 10 percent was given such medication, which is probably the ideal proportion.

Table 4.12 Distribution of children according to system of treatment received for diarrhoea

Area	Allopathy	Ayurveda	Homoeopathy	Others
Kadakampally	16(72.7)	4(18.2)	2(9.1)	
Vembayam	12(63.2)		2(10.5)	5(26.3)
Thidal	1(3.4)			28(96.6)
Suchindram	21(100)			

Table 4.13 Treatment details

Area	Inpatient	Outpatient	Advised tab/syrup/inj.		Given if advised	
			Yes	No	Yes	No
Kadakampally	21(95.5)	1(4.5)	22(100)		19(86.4)	3(13.6)
Vembayam		14(100)	14(100)		13(92.9)	1(7.1)
Thidal	1(3.4)	28(96.6)	26(89.7)	3(10.3)	21(77.8)	6(22.2)
Suchindram	6(30.0)	14(70.0)	20(100)		2(10.5)	17(89.5)

Figure 4.2 Total expenses for an episode of diarrhoea

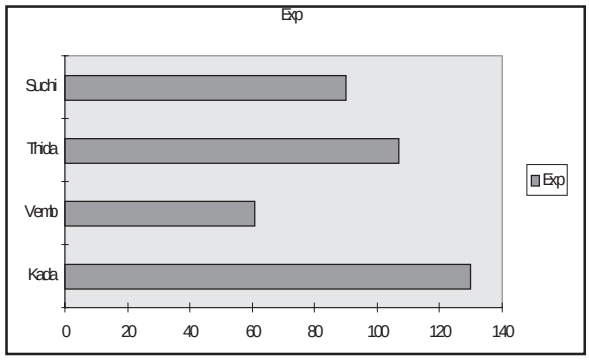


Table 4.14 Average expenses for treatment for an episode of diarrhoea (Rs)

Area	Drugs	Travel	Fees	Total expenses
Kadakampally	70.05	24.18	47.00	129.50
Vembayam	37.86	10.21	27.50	60.57
Tidal	49.39	16.60	79.86	107.00
Suchindram	80.00	5.83	34.36	90.00

The average expenditure for diarrhoea was the highest in Kadakampally and the lowest in Vembayam. The higher average expense in Kadakampally might have been due to the high levels of inpatient treatment in the area. The majority of patients in Vembayam were treated as outpatients thereby reducing the cost to almost 50 percent of that of Kadakampally.

Linkages between household practices and incidence of diarrhoea

We analysed the data to see the impact, if any, of household practices and socio-economic variables on the incidence of diarrhoea in children.

In the bivariate analysis, eating out was found to be significantly associated with incidence of diarrhoea. This might be due to the poor hygienic practices followed in the eating-places outside home. This brings the issue of educational campaign targeted on workers at the eating-places. Hand-washing before taking meals has been reported to be associated with lower prevalence of diarrhoea. This association was found in our sample also. Open-air defecation both of children and adults was significantly associated with high prevalence of diarrhoea morbidity.

All the variables found significantly associated with increased prevalence of diarrhoea were used in the multiple logistic regression models in which we considered diarrhoea as a dichotomous variable and the predicator variables as categorical variables. Hand-washing was the only variable which was found significant. Children whose mothers did not wash their hands had 2.24 fold risk of getting diarrhoea compared to those children whose mothers always washed their hands before feeding children (adjusted odds ratio 2.24, 95% CI 1.07-4.68). Impact of hand-washing on incidence of diarrhoea is reported elsewhere.

Table 4.15 Impact of various factors on incidence of diarrhoea (results of bivariate analysis)

Variables	No diarrhoea	Diarrhoea	Total	P Value
Eating out (child)	270(77)	82(23)	352(100)	0.003
Not Eating out	266(86)	44(14)	310(100)	
Eating out (adult)	257(77)	77(23)	334(100)	0.008
Not eating out	276(85)	48(15)	324(100)	
Frequency of cleaning hands before feeding child				
Not at all	204(81)	49(19)	253(100)	0.004
Occasionally	27(73)	10(27)	37(100)	
Mostly	137(75)	45(25)	182(100)	
Always	168(89)	21(11)	189(100)	
Type of toilet				
Children				
Open air	406(79)	106(21)	512(100)	0.041
Not open-air	127(87)	19(13)	146(100)	
Adult				
Open air	234(78)	68(22)	302(100)	
Not open-air	291(84)	56(16)	247(100)	0.045

Table 4.16 Impact of various factors on incidence of diarrhoea: Results of multiple logistic regression analysis

Variable	Reference Category	Beta (SE)	Odds Ratio	95% CI	P Value
Eating out (child)	Not eating out	0.48(0.48)	1.60	0.62-4.21	0.317
Eating out (adult)	Not eating out	0.37(0.47)	0.69	0.27-1.77	0.428
Hand washing	Always				
Mostly		0.69(0.35)	1.99	0.99-3.96	0.047
Occasionally		0.83(0.49)	2.30	0.86-6.16	0.090
Not at all		0.81(0.37)	2.24	1.07-4.68	0.029
Type of toilet					
Open air (child)	Not open-air	0.41(0.33)	1.51	0.79-2.90	0.203
Open air(adults)	Not open-air	0.23(0.26)	1.26	0.76-2.10	0.357

5 Summary and Conclusions

In our study of two villages each in Tamil Nadu and Kerala, the overall water quality in the villages studied was found to be unsatisfactory. In the control areas in both the states quality was slightly better than that in the study areas. This was an expected outcome. While in the control areas of Kadakampally and Suchindram 25 percent of water samples were satisfactory, in the study areas only less than 10 percent of water samples were satisfactory. Piped water was better than well water and other sources of water in all the areas studied. In Vembayam and Thidal, most people used well water and the quality of which was found to be quite poor. One of the reasons for not getting diseases even when they use bad quality water could be the better household practices they follow. Such practices include boiling water for drinking purposes, hand-washing before taking food, and using toilets.

These practices were more common in the study villages of Kerala. The differences in toilet usage practice of adults and of children were striking in all the areas, a phenomenon which needs attention from health educators and health authorities. This might be due to the wrong belief that children's faeces do not contain bacteria. Diarrhoea morbidity was higher in the study areas compared to that in control areas, particularly in Tamil Nadu. Overall morbidity was higher in Tamil Nadu than in Kerala. In the control areas of Kadakampally in Kerala and Suchindram in Tamil Nadu the rates were almost the same. The difference was in the study areas of Vembayam in Kerala and Thidal in Tamil Nadu. Thidal had significantly higher diarrhoea incidence than in Vembayam.

The basic difference between the two states seems to be in toilet facilities and household practices like hand-washing which are better in Kerala than in Tamil Nadu, while water quality was poor in both. Our finding of the protective effect of hand-washing needs to be propagated as a measure in preventing diarrhoea. Efforts should be taken to improve the quality of drinking water in both the States. Health education programmes should target specific areas like proper disposal of children's stools, and better household practices for caretakers of under-five children including grandmothers. Preventive measures such as chlorination of drinking water sources in rainy season, when the diarrhoea incidence was found to be the maximum, would yield rich dividend in the efforts to control acute diarrhoea. Management of diarrhoea also needs to be addressed. The finding that more than 90 percent of diarrhoea cases were treated as inpatients in Kadakampally *panchayat* has to be taken note of. Kadakampally has incurred the highest expenditure also on treatment of diarrhoea.

Our finding of a mean diarrhoea episode of 1.1 per child per is much lower than the figures reported for India as a whole. However, in the both study areas, particularly in Tamil Nadu, the mean episode was close to 2. Improvements have come about in areas in which water quality and household practices were better, the control areas contiguous with urban areas. Emphasis should be given in the rural areas in both States for providing safe drinking water and to improve household practices such as hand-washing before feeding children.