

IMPACT OF PROPER EXCRETA DISPOSAL
ON THE HEALTH STATUS OF
CHILDREN BELOW FIVE YEARS OF AGE
IN A SELLALE COMMUNITY

B Y

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A B S T R A C T

A large scale multi-disciplinary campaign which aimed at improving the agricultural, educational and health conditions of the general population of Sellale awraja was conducted in May 1981, during which, Muketuri, the present study area, was alleged to have achieved the maximum results by providing pit latrine facility to each and every household residing in the town.

An evaluative study on the impact of proper human waste disposal on the health status of children below 5 years of age was conducted from July 14 - 21, 1986, which is five years after the mass introduction of pit latrines as an intervention into Muketuri town. Assessment was also made on how residents of the town have formed the habit of using the facility after it was made available for them.

Because of lack of base line data, a similar community unaffected by the 1981 campaign, but comparable in respect to pertinent socio-demographic characteristics, was chosen as a control.

Intestinal parasitism, diarrheal illnesses, anthropometric measurements, infant and child deaths were chosen to measure health improvements that might have resulted from the intervention.

Weight and height, measuring scales and stool examination were the instruments used, for the observational data collection while a pre-tested and pre-structured questionnaire was employed for interviewing head of house holds and/or mothers.

Analysis of data collected from a total of 196 subjects and 85 controls living in 132 & 65 families respectively, has shown that pit - latrine facility availability was 81.8 % for the study group and 42.4 % for the controls. In the attempt to determine the people's motive to have a latrine facility, it was found that more than 60 % of families in Muketuri reported that the facilities were imposed by the Kebele, while self-initiation and advice from health workers were reported in 24.3 % and 15.0 % respectively.

All available pits were found to be utilized, but about 25 % were deficient from a sanitary and hygienic utilization point of view. No significant difference was observed on utilization behavior of the two communities.

Of all socioeconomic variables of families, income was found to be significantly ($P < 0.01$) related to both availability and utilization of the pit latrine facility, while education of the head of the house hold was found related to availability only. Utilization was also seen to be increased among self-initiated latrine owners, compared to those who own the facility through Kebele imposition or through health workers' advice.

Study results demonstrated an over all health improvement among the study group than their controls. Prevalence of intestinal parasites was 32.2 % and 56.6 % ($P \leq 0.01$) among children studied in Muketuri and Chanco respectively. Multiple intestinal parasitism among the positives, was also higher in the controls than in subjects, 32.6 % VS. 5.4 %.

Analysis of anthropometric measurements using Waterlow's classification, revealed that protein - energy malnutrition was common among both groups of children. However, comparison between the two groups show a more improved condition among the study subjects than the controls.

The two-weeks recall period prevalence of child diarrhea was also found to be higher among the controls, 15.3 . Vs 11.7 % . But the difference was not statistically significant.

Results in general indicate that provision of excreta disposal facility may reduce the prevalence of intestinal parasitic infections, diarrheal diseases and malnutrition and may result in general health improvement of children below 5 years of age. Availability of latrine in a family, however, may not protect children individually, unless the overall contamination of the environment of the community is prevented.

The less - effective inputs by health workers alone and the importance of multisectoral approach is also discussed.

1. INTRODUCTION

1.1 Statement of the Problem

The intuitive knowledge of the association between sanitation and health seems to have existed since the earlier days of man's civilization, during which sanitary waste disposal practices were documented (1). Scientifically based knowledge, however, was following the germ theory and discovery of etiological agents of diseases in the mid-nineteenth century (2). Since then, most plans and programmes aimed at promotion of health and prevention of diseases, have fully or in part stemmed from sanitation activities.

Improved levels of health and control of communicable diseases in the developed world today have been attributed mainly to socio-economic growth and attainment of optimum sanitary conditions (1,3). Furthermore, poor levels of these situations coupled with rampant epidemic and endemic diseases in least developed countries support the attribution made in the affluent countries.

A large proportion of the world's population, particularly of the developing countries is at present overwhelmed by enteric diseases and its consequences. Global estimations by the World Health Organization (WHO) and other sources (4-6), indicate that 3-5 billion attacks of diarrhea illnesses and 5-10 millions of diarrhea - associated deaths occur each year in Africa, Asia and Latin America. This grave situation mostly

victimizes children below five years of age. The number of intestinal parasitic infections, single and multiple, are also estimated to exceed the total population of the world at one point in time (5). It is apparent that these problems are skewed to that part of the world where transmission of these diseases is facilitated by deficient supply of safe water and inadequate sanitation.

Unsanitary disposal of human excreta has been identified to be the major focus of infection for most enteric and worm diseases. Spread of these diseases is through man's contact with human excreta directly through hands, water, food and soil or indirectly through arthropods (7,8).

In response to the prevailing enteric and helmenthic diseases, and in the light of experiences of the developed countries, nearly all countries, mainly the poor, have become increasingly aware of the importance of sanitation.

Acceptance of Primary Health Care (9) and commitment to the International Drinking Water Supply and Sanitation Decade (10) have engaged countries in striving to improve the health conditions of their populations. The trend seen in sanitation coverage is part of the evidence for the effort being made. Globally, the urban and rural population with basic sanitary facilities in 1970 was, 54 % and 9 % respectively. In 1980, it was 50 % for the urban and 13 % for the rural population.

The coverage for 1983 still showed an improvement, in which 54 % of the urban and 14 % of the rural were estimated to be covered. It is also anticipated that, by 1990, three-quarters of the urban and 35 % of the rural population of the world will have access to adequate sanitation (11 - 14).

In Ethiopia, like in any other underdeveloped country, sanitation related diseases are among the major public health problems facing the country. Systematic and reliable nationwide data on the magnitude of the problem is lacking. Under the present conditions of reporting system, reports from health institutions and fragmented studies reveal that, diarrheal diseases and intestinal parasitic infections are the leading causes of morbidity in the country at present.

Gabre-Emanuel (15) reviewed most of the relevant documents and studies done earlier, and brought excreta borne diseases into the picture as a major public health problem in the country. He has shown that, these diseases in-variably affect all population groups in every setting. Excreta-borne diseases, particularly intestinal parasitic infections, have also been described by Siyoum et al(16), Gebresellassie (17), Zein and Mekonen (18) as one of the priority problems that deserve attention for prevention and control.

The magnitude of enteric infections have also been stated by the Ministry of Health through its official reports. In 1983/84 for example, more than 17 % of all patient visits to health

institutions in the country were either for diarrhea or for intestinal parasitic infections during which these two ailments ranked first and second respectively among the top morbid diseases (19). Similarly, a summary of diarrhea morbidity and mortality studies in nine regions carried out by the office of National Control of Diarrheal Diseases in 1985, indicated the range of diarrheal incidence among children below 5 years of age, as 2.8 % in Wollo to 7 % in Eritrea. The same document revealed diarrhea - associated deaths to be 1.3 % in Gondar and 27 % in Eritrea (20).

Diseases related to poor sanitation, not only are major health problems, but also present themselves as problems in other sectors. Diarrheal diseases and intestinal parasites have a direct and/or indirect bearing effect on the economy of the country. In relatively simple terms of estimation, Cabre-Emanuel (15) has shown that, a one year treatment cost for ascaris infections alone could reach 29.4 million Birr (\$ 14.1 million US). In addition, these diseases have been noted to take shares of the limited hospital resources in the country. Lainoric (21) in Dire Dawa found out that out of total hospital admissions in 1974, intestinal parasitic diseases represented 15.1 %. Similarly, the Ministry of Health indicated that in 1983/84, out of all hospital admissions in the country 2.5 % was for dysentery of all forms (19).

In the light of this problem, the need to improve the sanitation condition in Ethiopia, seems to have been recognized since the early fifties of this century. The promulgation of the Municipal

Sanitary Rules in 1951 (22), and the move to integrate preventive and curative services around 1958 (23) were prominent evidences. Since then, it has intuitively been considered that, more than three-quarters of the prevailing communicable diseases in the country can be prevented by technically simple measures of improving sanitation and water, immunization and health education (24). This generalization, though not evidenced, seem to have won thinkings of health professionals and policy makers, and did form the material basis for health policy formulations.

The National Democratic Revolutionary program (25), and the program of the Worker's Party of Ethiopia (26) have identified sanitation improvement as one of the priority needs of the country and made favourable conditions for primary health care and sanitation decade activities. These activities were incorporated in the Ten years ' Perspective Development Plan (27) which is being implemented since 1984. In the Ten years ' Plan for example, it is indicated that, by the time the plan period terminates in 1993, six million new pit latrines will be added to what the general population in the country owned.

For successful plan implementation and effective program operations, among all other essential ingredients, knowledge of the past experiences, of the achievements and of the present status and remaining gap is required. Besides, the effect of the program on health, either achieved or expected should be determined. However, reliable data on sanitation in respect to these elements, is practically non-existent.

Surveys conducted by the Central Statistics Office in 1980 (28) and 1983 (29), gave the general picture of urban and rural sanitation status in the country. The 1980 survey has shown that sanitary facility of any kind was available in only 54.33 % of the households in seventeen major towns (excluding Addis Ababa and Asmara) in the Country. The situation for the rural majority of the country was assessed recently in a two-round rural health survey in 1982/83. According to the results of this survey, pit-latrine facility was available in only 8.9 % and 7.4 % of the rural population in rounds one and two respectively. Project proposals for the rural and urban sanitation in Ethiopia, that were presented in 1981 and 1983 (30,31), estimated the proportion of the rural and urban populations that have an access to any sanitary facility as 3.8 % and 20 % respectively. Such types of surveys and estimations, however, are simply information on availability alone, which does not enable one to determine the contributions of sanitation to health in general and to reduction of fecal-borne diseases in particular.

It has generally been accepted that, sanitary measures of various methods, known as "sanitary barrier", will break the chain of many infectious diseases and consequently reduce the transmission of enteric and helminthic infections (8, 15, 32). Based on this assumption, studies have been carried out to explain and demonstrate how much the "sanitary barrier" influences the occurrence of enteric diseases such as diarrheal and intestinal parasitic infections. Most of the previous works attempted to

show the impact of sanitary facility on diseases by comparing rates in families and communities with and without the facility.

Mc Cabe et al (33), demonstrated the effectiveness of proper excreta disposal on the control of shigella infections, by using a bore-hole latrine. In their study, the breeding of house fly was curtailed, and as a result shigella infections in children below 10 years of age was reduced by half from those without the facility. Similarly, Rubenstien et al (34) compared two groups of children, one in a community with sanitary facility and the other without, on their hospital visit for diarrhea. He found out that usage by those with the facility declined while it remained unchanged in the other. Rubenstien's comparison and Mc Cabes results clearly show that, the presence of sanitary facility plays a role in the reduction of diarrheal occurrence among children. Hans A. Brush et al (35) in Gutemala, further confirmed the importance of pit-privy by considering the regular use of these privies. They found out that diarrheal diseases decreased among children from households with privies. However, their finding did not hold true for children below 1 year of age.

Schliessmann (36), and Van Zijl et al (37) have described the decrease in diarrheal morbidity and its inverse relationship with improved sanitary conditions of the community. Azurin and Alvano (38), were able to give quantified benefits of using latrine facility in their 5 years long study of cholera in the Phillipines.

They indicated that cholera incidence was reduced by 68 % in the community using improved sanitation when compared to those without the provision. They have also shown that the incidence was further decreased by combining sanitation with safe water supply.

The impact of sanitation has also been shown by its influence on intestinal parasitic infections. Chandler (39) studied two Egyptian villages for two years following an intervention including bore hole latrine in one of them. The reduction of helminthic infection from 60 % to 52 % was believed to result from the sanitary installations for the fact that the rate for the controls was found to reach 70 % after treatment. In this study the effect on protozoal infection was found unchanged in both groups. In west Indies, St, Lucia, Fitzroy (40) demonstrated the effect of improved sanitation on the fall of prevalence and intensity of diarrhea and intestinal parasitic infections among children. The study has also shown an association between sanitation improvement and improved growth.

Walter et al (41) have recorded reduction in hook worm positivity, from 37.6 % to 25.4 % in 4 years after mass introduction of about 18,000 pit latrines in several rural villages in Brazil. They pointed out that success would have been greater, had all the privies been utilized and maintained. Moore et al (42) described the effect of sanitary excreta disposal, after they found a high prevalence rate of ascaris in places where no latrine facility was available.

The influence of environmental sanitation on health and its effect in the reduction of infant mortality has also been described by different investigators. Improved sanitation was noted to reduce infant mortality rates (43,44). Based on the knowledge that infection and nutrition have an effect upon one another, there are studies carried out to show the inter-relationships of environmental sanitation with either diarrrheal diseases or helmenthic infections on one hand, and nutritional status on the other. Observation of higher rates of under-nutrition in children who harbour intestinal parasites in comparision with those who were free (45), and the speculation made that diarrhea may play a key role in the genesis of undernutrition (46) suggests the possiblity of an association between poor sanitation and nutritional anomalies.

Improvement in environmental sanitation was also noted to improve nutritional status of a given population. The results of victoria's (47) and Herberts' (48) studies, by which nutritional status of children was shown to be strongly associated with the environmental factors such as housing, overcrowding and excreta disposal habits of parents has supported this hypothesis. Since the cause and effect relationships between infection and malnutrition has not yet been established, study results made so far are not conclusive. However, results of different studies (49, 50, 51), have consistently indicated the link between nutrition and infection. Housing, sanitary facilities, water supply and personal hygiene have also been demonstrated as having an effect on the health status of populations (52-56).

Not all studies reveal the positive impact of improved sanitation on health. In Egypt in 1952, there were study conclusions put forward which indicated that installation of water supply and latrine facility have no effect on death rates (57). Butz (58) also reported, that piped water and toilet sanitation did not show an impact to reduce mortality. Other studies have also pointed out the ineffectiveness of improved sanitation unless the people are educated on the use of the facility (59,60).

Explaining the basic concept that a "sanitary barrier" will break the chain and reduce the transmission of fecal-borne diseases and its ultimate health benefits, in measurable evidences, has been a challenge to researchers. Reduction of enteric and worm diseases by sanitary practices is presumed to be followed by health improvements. Improving sanitation may also result in better socioeconomic and nutritional status, which in itself has an impact on health status. These interrelated situations do not lend themselves for quantification by the health indicators most often used (14, 56, 62-64).

This complex nature of the subject influenced earlier studies to vary in design, results and conclusions. Blum and Feachem (65) after examining more than 50 previous studies on sanitation impact, identified eight major methodological problems. Nearly all of these studies had suffered from one or more of the problems, which sometimes resulted in erroneous and conflicting conclusions.

In spite of all these hindrances, there is need for research in the area of sanitation and its impact on health for development of the concept itself. Apart from the recommendations of Blum and Feachem (65) and proposed change in approaching the subject (66), the attempt to elaborate the concept of sanitation and its inter-relationship with health and socioeconomy by Shuval (67) is an indication of progress. These developments will hopefully narrow differences in opinions and doubts on the effectiveness of sanitary interventions.

In view of implementing primary health care and the sanitation decade's programs the need for further knowledge, and understanding about sanitation activities and its health effect is far greater. It is with this logical basis that the present study was conducted.

1.2 Purpose of the Study

1.2.1 Aims :

The present study was conducted primarily with the aim of examining how provision of pit-latrine facilities function to solve health problems in the community.

Secondly, the study aimed at assessing how pit latrine facilities are utilized after being made available, and how much understanding has been reached between the community members as targets of behavioural change and health workers as change agents.

Thirdly, the study was intended to determine trends of health improvement of the community in general, on children in particular, where pitlatrine intervention. was introduced.

1.2.2 Objectives :

The specific objectives of the study were

- a) To assess the extent of pit-latrine utilization by the families of children below 5 years of age after the facility was available to them.
- b) To determine the impact of proper excreta disposal on health status of children below 5 years of age by comparing two groups of populations, one with the facility, the other without, on the following health indicators.
 - (i) Prevalence of intestinal parastic infections.
 - (ii) Prevalence of diarrhea
 - (iii) Prevalence of protein energy malnutrition.
 - (iv) Infant and child mortality rates

These being the objectives of the study, the null (H_0) and alternative (H_1) hypotheses were formulated as follows :

H_0 = The rates of the selected health indicators among children in the intervention area will not significantly differ from those in the area where a pit latrine facility was not provided.

H_1 = The rates of the selected health indicators will be significantly lower among children in the intervention area than in those living in the area where the intervention was not introduced.

1.2.3 Significance of the study :

The importance of improved sanitation and proper excreta disposal in the process of health promotion and disease prevention has long been identified and loudly spoken of in the field of public health (1). It was also described in the Declaration of Alma-Ata in 1978 (9) as being one of the essential primary health care components. The resolution of the United Nations Water conference (10) , to launch a program of improving water supply and sanitation, signifies the role that sanitation could potentially play towards reaching the global goal " Health For All by the Year 2000 ".

Results of this study can be of great help to health planners and professionals in developing new strategies and modifying the existing ones. It would serve as a feed back to the installation of 6 million pit latrines throughout the country during the 10 years plan period (27).

Findings of the study can also provide health administrators and program managers with quantified information, which will form a prerequisite in the process of priority setting and decision making.

The present study being a novel start in the country , will lay a foundation and will give way to further studies in the sphere of environmental health.

1.3 Nature of the Study :

The present study was conducted to evaluate the outcomes of an intervention in relation to changes in the health level of a community, particularly of children below 5 years of age , following its introduction. The intervention under evaluation was, the pit-latrine facility which was introduced into a read side town through a mass campaign in May 1981. The study was designed within the framework of the assumption that pitlatrine provision and its utilization will have a beneficial effect on the health status of that community to which the facility was available.

Since base-line data was not collected during the introduction of the intervention, this study is precisely an " after- test.", In order to be able to look for possible association between the independent and the dependent variables, which are, the pitlatrine facility and health status improvement respectively, another similar community but without the intervention, was chosen for comparison.

Thus, the nature of this study is a "post - test " evaluative study (2, 68, 69).

1.4 Operational Definitions

In this particular study variables are operationally defined as follows :

- 1.4.1 Impact : WHO definition for impact is adopted (10) and is used in this study as, the overall effect of proper excreta disposal on the health of study subjects.
- 1.4.2 Proper excreta disposal : safe disposal of human wastes, treated or untreated, into a pit latrine which is constructed properly on an appropriate site.
- 1.4.3 Health status : the state of health of study subjects as measured by health indicators used in the study.
- 1.4.4 Health indicators : Indicators selected as yardstick in this study are :
 - a) Prevalence of intestinal parasites : proportion of study subjects, whose stool examination revealed positive for one or more types of pathogenic protozoal or helminthic eggs and/or cysts.

b) Prevalence of protein-energy malnutrition:

Proportion of study subjects with low weight-for - height and low height - for - age cross tabulated to yield wasting, stunting, and wasting and stunting combined, using Water low's classification (71).

c) Provalense of diarrhea : Proportion of subjects with diarrhea in the two weeks preceding the interview as revealed by respondents' recall.

1.4.5 Availability : a sanitary facility of any kind for human waste disposal is said to be available, when a family owns or shares a facility near by the residential area.

1.4.6 Utilization : available facility is said to be utilized when all members of a family defecates in the latrine during their presence in their home.

1.4.7 Family : all members living in a household from which a study subject was selected for this study.

1.5 Assumptions

The present study was conducted based on the following assumptions

1.5.1 In the study communities, provision of excreta disposal facility such as a pit latrine, will be properly utilized and maintained, If pit latrines are used and maintained,

transmission of fecal borne diseases will be reduced and will result in the reduction of the prevalence of enteric infections will result in the improvement of the health status of the population studied.

- 1.5.2 Health gains from pit latrine availability and utilization, can be quantitatively measured by the indicators selected in this study.

1.6 Scope and Limitations of the Study

The study was conducted in two small road side towns, over a group of populations in the age range of 0-4 years. In evaluative studies such as the present one, studies of populations of adequate size in different places will yield reliable results. However, this study was confined to a relatively small community from which a segment of the population were selected.

Evaluation of the impact of an intervention ideally requires a "before " and "after " data collection from which differences would be attributed to the intervention. In this study, however, lack of " before " data inhibits generating such inferences.

In studying the impact of an intervention, comparison of data from the study group with two or more control groups is safe when the population size is adequately large, and is more valid when the two populations are comparable in size. In the present study,

due to unavoidable constraints of time and money, which indeed are determinants, the control group chosen was only a sample, while the study subjects were total population.

In the process of data collection, using the same enumerators throughout, will keep the data consistent and variations will be minimal. In this study, due to the reasons mentioned earlier, to use the same enumerators on both populations was not possible. Thus two different groups of enumerators were used for anthropometric measurements in the study areas. These type of arrangements are possibly prone to the introduction of observer's variation, which if great, will affect the results.

In assessing the pit-latrine utilization behavior or a community the total population or a representative sample should be considered. In this study however, data was only collected from households where eligibles were found, without considering their representativeness to the parent population.

2. METHODOLOGY

2.1 Study Areas

The study was carried out in two road-side towns in northern part of Shoa Administrative Region. Both towns are located on the central plateau with an altitude between 2000 - 2500 meters above sea level. The two towns are capitals of two adjacent woredas belonging to two different Awrajas. The towns are :

- 2.1.1 Muketuri : is situated 80 kms. north of Addis Ababa along the main road to Gojjam Region. With a population of 1218, predominantly Oromos, Muketuri town is divided into three small zones under one " Kebele " ^{*}. The town has one secondary school up to grade eleven. Available public services include all weather road, postal service, and telephone, but no electricity. Water supply for the town is from a deep well through unevenly distributed standpipes with very few house connections. In Muketuri, there is one health station with two health assistants rendering services to the population of the town and its vicinity. Services given include, diagnosis and treatment of ambulatory patients, ante-natal programmes, sick baby clinic, a once in a month static ^a and three other outreach ^b immunization

* urban dwellers association

a - static immunization program is given on the site where the health institution runs it by itself.

b- out reach program is when health team goes out for vaccination & returns after the program.

programmes, health education and an irregularly conducted town-health service. Delivery services are given by the health assistants and untrained traditional birth attendants. There are no community health agents or trained birth attendants. Monthly morbidity reports are poorly kept and irregularly made. Review of the 1985/86 morbidity reports made by Fidche health center indicated that, acute upper respiratory infections, all types of skin diseases, all types of diarrhea, fever of unknown origin and helminthic infections were that most commonly seen diseases in Muketuri clinic.

Selection of Muketuri as a study area was based on a mass campaign that took place throughout sellale awraja in May 1981. The campaign was multidisciplinary, of which provision of a pit latrine to each and every household in the awraja was a part. During this large-scale campaign, Muketuri was alleged to have achieved the maximum, and it was declared by the mass media that all dwellers of the town had their own latrines. Assuming the information was true, this study was planned to measure the health benefits of the intervention, about five years after its introduction into the community.

2.1.2 Chancho : is the other town selected for this study. It is located 40 kms. south of Muketuri. Chancho has a population of 2301, whose majority, like Muketuri, are members of the Ethiopian Orthodox church and the dominant ethnic group is Oromo. The town is divided into five zones under one

'kebele'. There is one government dementary school. Except electricity, the basic public services, like postal, telephone and road transport are available. Water supply for chanco is from a deep well distributed through scattered stand pipes and a few house connection. In Chanco, there is one health center with two nurses and five health assistants. There is no functional laboratory facility, except occasional sputum examinations for acid fast bacilli by a health assistant with only two-weeks training at the tuberculosis center in Addis Ababa. Services rendered by the health center include all types of programs, like that given in Muketuri clinic and additionally a monthly family planning program. The health center has also 3 beds for emergency admissions and maternity services. The health center did not have a Sanitarian until one week prior to the start of this study, but was present during data collection. Review of the 1985/86 annual report of the health center at Shoa Regional Health Department revealed that upper respiratory infections, all types of dearrhea, helminthic infections eye diseases and skin infections were the most common causes for patient visits to the health center.

Selection of Chanco is primarily based on its comparability with Muketuri, in regard to the variables that are assumed to have an influence over the subjects to be studied except the intervention. Thus, Chanco was selected as a control community.

2.2 Study Populations

The population of interest in this study were children below the age of 5 years (0 - 59 months). This age group was chosen, because of the following reasons :

2.2.1 These groups of populations were born after the introduction of the intervention in 1981. Fecal-borne diseases, that they might have developed was certainly after the intervention. This provides the opportunity to determine the antecedence of the exposure to risk factors, increasing the safety of making an association.

2.2.2 This age group is more vulnerable to infection than others, and it was believed that changes in the health status is easily detected using the indicators selected in the study.

Identification of eligibles for the study was from the census that was conducted 1 week prior to data collection. The census was carried out by students who completed grade 12. Enumerators, after a short training, were assigned into different zones, mostly into zones where they reside. House numbers of the 'Kebeles ' were used for identification of houses. Different sequential numbers were developed for those houses without numbers, to be written with chalk over the doors as high up as possible

to prevent erasing by rain or otherwise. Omission and/or duplication of visiting a house was prevented by clearly defining boundaries of zones where an enumerator was assigned. House to house visit was then conducted listing all members by age and sex.

Age of an eligible was determined exclusively from parents, in which respondents were assisted to bring their recall close to correct date of birth by calling significant holidays and other events commonly known by the community. Age was then recorded on the forms provided in months to the last complete unit.

After having the complete list of children of the specified age, in both study places, except those found to be non-resident, size of study population was determined as follows.

Subjects from Muketuri - (study group):

The census revealed a total of 205 children in the age group of 0-4 years (0-59 months). It was thought that the size was manageable, and it was decided to enroll all of them in the study. Thus, this study group population was 205.

Subjects from Chancho - (control group)

The census in chancho gave a total of 382 children in the age group selected for the study. In view of the constraints of time and money, drawing a representative sample was felt necessary. In doing so, the need for a sample of adequate size was at the same time felt, and it was decided to take 25 % of the population, a size closer to a maximum for a sample.

The sampling technique employed was stratified - simple random sampling. Choice of this technique was to prevent the influence of place of residence. Enumeration of study populations by residential zones made the sampling technique easier for application. The sample was proportionally allocated to each zone (stratum). Selection from each stratum was using a random table from WHO's guideline for a sample survey of diarrheal diseases. Using the random number was, first, row and column was located by pointing a pencil while eyes were closed, then a two digit horizontal reading from left to right was performed until the number of subjects allocated to each zone was selected. Finally the sum of sub-samples from each stratum was determined. The sample size, taken as control group in Chancho was a total of 96 children.

2.3 Data Collection

Before data collection was started, the investigator had initially obtained the consent of government and mass organizations' agencies, and their willingness to cooperate in facilitating data collection.

Data collection was first carried out in Muketuri and then in Chancho from July 14th to 18th and July 19th to 21st, 1986 respectively and was completed in eight days.

Four teams, each composed of a sanitarian as a team leader, and two students of 12th grade education, were formed in each study place. The same sanitarians were used in both places, while the others were selected from their respective towns. Division of labour among team members was appropriated. The team members other than the sanitarians, had participated during the census, a fact which made training on data collection less difficult. Similarly, the sanitarians were senior staff members of Environmental Health Department in the Ministry of Health, and all of them were experienced in field work and communication with community members like the ones studied.

2.3.1 Methods of data collection :

a) Interview method :

One of the methods chosen for data collection in this study was interviewing the head of the household and/or the mother or guardian of study subjects.

b) Observation method :

Another method of data collection employed in this study was the observation method. This method was used to collect three sets of data.

- (i) Anthropometry : Every subject under this study was measured for height, weight and arm - circumference.
- (ii) Stool examination: About 5 grams of stool specimen was collected and examined for eggs and/or cysts of pathogenic intestinal parasites.
- (iii) Sanitary inspection : every household where a study subject was found, was inspected on, compound sanitation, latrines (if any), and water storage and use at home.

2.3.2 Measuring instruments :

- a) Questionnaire*: Pre-structured and pre-tested questionnaire was used for data collection. It was designed as precise as possible, in order to avoid ambiguity, unnecessary information collection, and to help the interviewer and respondent understand each other. The questionnaire, before it was finalized was commented upon by experts in the Department of Environmental Health, Ministry of Health, and Community Health Department, Faculty of medicine.

* see annex for the type of the questionnaire.

It was designed in such a way as to allow quantification of responses by allocating weighted scores ^a to each response of corresponding questions.

b) Anthropometry : for anthropometric measurements, instruments used were.

(i) Weighing : two types of weighing scales were used. The beam scale (lever type) was used for weighing all subjects who were unable to stand by themselves. For these who were able to stand on their own the " salter " bathroom scale was used. Readings from both were in Metric system.

(ii) Length (height) :

height measurement was also employed using two types of measuring equipment. For children who were not able to stand erect, a horizontal wooden board with a tape measure on it was used. The board has one fixed head-piece and movable foot-piece. It measures upto 100 cm. For the rest of the subjects, a wooden stick with a tape measure on it was used. Readings were in centimeters.

(iii) Mid-arm circumference: arm circumference was measured using a plastic coated measuring tape, calibrated in centimeters.

a - see annex for scores corresponding to the questions.

- (iv) Stool examination: stool of every subject who was able to produce the specimen, was examined under the light microscope using Formalin-Ether concentration technique.

2.3.3 Procedures :

- a) Interview - the team leader, who was also the interviewer, introduced himself and his colleagues, to the head of the household, and obtained the consent of the respondent. On finishing the introduction, he started questioning on the basis of the questionnaire which had four parts of questions on :
- (i) Family identification: the first part of the interview was on demographic and socioeconomic characteristics of the head of the house hold and the rest of the family members.
- (ii) Children's diarrheal episode and death :-
the second part of the interview was on diarrhea in the two weeks preceeding the interview. Questions were also asked on whether there was a child death in the past year. It also specified, whether death was diarrhea associated.
- (iii) A vailability and utilization of latrine:-
the third part of the interview was on whether the family owned a pit latrine, and if available, on how they use and maintain the facility.

(iv) Water supply :

the fourth and the last part of the interview was on the supply, storage and usage of water.

After the interview was over, the second procedure followed.

b) Anthropometry :

Weight of every subject was measured by the other two members of the team. Heavy clothes, shoes and other objects were removed, before weight was taken. The scale was adjusted at zero before each measurement. Readings were recorded in the space provided on the questionnaire by the interviewer. The interviewer re-read and recorded to the nearest 100 grams. In some situations when a child refused, the weight of the mother with and without the child was measured and the difference was recorded as the weight of the child.

Height was taken by the same enumerators.. Measuring with the horizontal board was by placing the child in a recumbent position, keeping the head against the fixed head piece which starts at zero cm. The movable foot-piece was then adjusted until it comes in contact to the heel of the child. The child is kept straight against the board by pressing slightly over the knee so that accurate length of the child is read. Reading was made from the inner surface of the movable foot piece,

and recorded to the nearest 0.1 cm. Here again, the interviewer re-read the measurement before recording.

Measurement of height using the wooden stick was carried out by taking off shoes, if any, and placing the subject on a flat surface standing erect, assuring that the back and the calf touched the stick, then the level where his skull reached was recorded to the nearest 0.1 cm. The interviewer always checked the readings before he recorded.

Mid-arm circumference was measured by plastic coated measuring tape. The left arm of the subject was kept hanging, with a support at the finger tip by the mother if necessary.

Mid - point for measurement was located by placing the thumb on the promineat bone of the shoulder (achromion) and the little finger on the prominent bone of the ulna (olecranon), the site was then approximated by the middle finger (72,78). The measuring tape was then wound around the arm without ti tightening or lossening, Reading was taken and recorded to the nearest 0.1 cm

- c) Stool examination : After interview and anthropometric measurements were completed at each house hold, the team leader provided the mother with a plastic sheet of about 15cm by 20 cm. The mother was fully instructed to bring a specimen of stool of the subject into a central place chosen to be closer for all mothers. Then stool, when brought to the central place, the mother was

requested for the card she was given during the interview. The card with code number of the child on it, was counter checked on the registration list. Then the specimen was placed into a bottle with a code number corresponding to that of the child. The bottle was then tightly closed and shaken before putting it into the box. Stool preservation was carried out entirely by the investigator. In case of the presence of more than one subject in the family, different colors of plastic sheets were used as stool containers, to assist mothers identify easily. Blue color for the eldest, black for the second and yellow for the third child was consistently used. Preserved stool was brought to Addis Ababa for examination in the Institute of Pathobiology. The method used for stool examination was RITCHIE formalin-ether concentration method (74). Stool examination was done by the investigator assisted by technicians of the Institute. Results for each specimen were recorded as " + " for positives of any pathogen and " - " for negatives, and was recorded on a special form prepared for this purpose.

d) Control of quality of data :

Throughout the process of data collection, that is, before and during data collection, efforts were made to maintain the quality of the data. Of the steps taken, the main ones are the following:

- (i) Questionnaire development : the questionnaire design was based on clarity of words, simplicity of questions, simplicity in recording, and its preciseness. Before the questionnaire was finalized, efforts were made to obtain technical advice from experienced professionals and experts on the field of environmental health, on each question and choices for answers. The draft questionnaire was given to some of the consulted experts. It was then pre-tested in Chanco health center on 20 mothers attending Maternal and child Health sessions. Time estimations, the acceptability of each question, and choice of words for some questions were assessed and valuable modifications were made. It was then finally structured and used.
- (ii) Training : In order to maintain the quality of the data, the quality of the interviewers and enumerators was considered. Choice of sanitarians for interviewing was on this ground. In view of some of the technicalities involved in the data collection, it was felt that, some element of skill in the field was essential which otherwise would have been difficult to train a lay person. Similarly, choice of 12th grade students for enumerating anthropometric data was based on their performance during the census.

Selected data collectors were then trained in each aspect of data collection. Training for interviewers included on how to approach a house hold head or the respondent. In order to keep uniformly and reduce variation among enumerators, practical demonstrations was held in the health institution which included reading the same measurement by each enumerator separately, how to handle, operate and check the instruments at interval for their consistency. The sanitarians were additionally trained how to supervise their team members during taking anthropometric measurements.

- (iii) Supervision : every team was supervised by the investigator at any two-household visits every morning. The daily work for each team (number of houses), were determined before and after noon. Each team leader was expected to submit his half-day work before he was given the second half. Every questionnaire was then edited for incompleteness, by the investingator during submission. In addition, a short group discussion was held every evening in the hotel where the team had stayed, on problems encountered during the day. Each anthropometric reading was also checked by the team leader before it was finally recorded.

2.4 Data Analysis

In reference to the objectives of the study all relevant data were collected from both study areas.

Data analysis was initially planned, before it was collected. The framework for assembling and summarizing data was prepared prior to the collection, in the form of dummy tables. This helped to investigator to organize the data for analysis.

In order to compare findings in the study and control groups, computations and calculations were made as follows :

2.4.1 Prevalence of diarrhea : All positive recall responses, within 2 weeks preceeding the interview, that is, all diarrhea episodes that started within the 2 weeks prior to the data of the interview were counted. The two-week prevalence rate of diarrhea was calculated for both the study and the control groups as follows :

$$\text{Prevalence} = P = \frac{\text{All postive responses for diarrhea in two weeks preceeding the interview}}{\text{Total number of the study population available during the date of the interview}} \times 100$$

2.4.2 Prevalence of intestinal parasite : Results of the stool examinations were recorded as positives (+) and negatives ('-') by species against the code number to each subject. All positives for a single species and total positives for any of the species were computed separately to give prevalence of individual parasite and over all prevalence of intestinal parasites as follows :

Prevalence of individual parasite (P_1)

$$P_1 = \frac{\text{Total number of positives for one single species or a parasite}}{\text{Total number of subjects whose stool was examined and found positive}} \times 100$$

Overall Prevalence rate of intestinal parasites (P_T)

$$P_T = \frac{\text{Total number of positives for any pathogenic parasites}}{\text{Total number of subjects whose stool was examined}} \times 100$$

2.4.3 Prevalence of protein - energy - malnutrition :

To analyze anthropometric measurements, the method described by Waterlow (71) was adapted. In order to use this method, individual height, weight and age of each subject was compared to the median height - for - age and median weight - for - height of a reference population (75,76) taking - 2SD from the median as a cut - off point. Selection of the cut - off point was according to the Waterlow's recommendation for countries where under nutrition is a problem. Thus all children were classified between $\geq -2SD$ and $< -2SD$ of the median height - for - age, and weight - for - height. This classification gave the following four categories.

(i) by height - for - age

- those who are $\geq$ - 2SD to the median for
the reference pop.
- those who are $<$ - 2SD " "

(ii) by weight for - height

- those who are $\geq$ - 2SD " "
- those who are $<$ - 2SD " "

The four groups were :

Cross - tabulated by height - for - age and weight - for
height into a 2 x 2 table as follows :

		Height - for - age (Z - score)	
		$\geq$ - 2SD	$<$ - 2SD
Weight - for - height	$\geq$ - 2SD	NORMAL	STUNTED
	$<$ - 2SD	WASTED	WASTED + STUNTED

The proportion of subjects who were found to be normal, stunted,
wasted and, stunted and wasted combined were computed for both
Muketuri and Chanchó.

2.4.4 Utilization and maintainance of Pit-latrine :

As described above, for all responses, weighted scores were allocated. For each house hold, scores were added and total utilization and maintainance score was determined. Mean score value for families who have latrine facility in both study areas was computed. Then, the proportion of Utilization score for Muketuri and Chanco was calculated in comparison to a theoretical standard value.

2.4.5 Water supply and utilization :

Data on water supply and use was analysed in the same way as was done for Latrine Utilization.

2.4.6 Mortality rate and diarrhea - associated death rates :

These rates for deaths was not analyzed, due to the fact that data on these variables were found too low, to allow making conclusions. It was therefore, omitted.

2.5 Statistical Methods

Computed rates and means for the study and the control groups were compared and tests for significance using the chi - square (X^2) and Z - test methods were performed.

3 - RESULTS

3.1 Demographic Characteristics of the Study Populations

Two hundred and five children aged 0-4 years in a total of 135 households in Muketuri, and 96 children from 91 families in Chancho were initially selected for the study.

In Muketuri, out of the 205 children and 135 households, data was collected from 196 children who lived in 132 households, making the coverage to be 96 % and 98 % respectively. Similarly 85 children in 85 households, which was 89 % and 93 %, were covered in Chancho. The only reason for non - response in both of the study areas was unavailability of the family throughout the period of data collection.

Comparison of the study and the control populations from whom data was collected is presented in table I.

Subjects in Muketuri were 51.0 % males and 49 % females, while their counterparts in Chancho were 50.5 % and 49.5 % respectively. Distribution by age show that the group below the age of 12 months in Muketuri constituted nearly a quarter of the total study population, while in the controls, it was only less than 10 %. On the other hand, children aged 36 months and above comprised 37.8 % against 49.5 % in Chancho.

Table 1. Age - sex distribution of Children studied in Muketuri & Chanocho, July 1946.

Age group (in months)	MUKETURI				CHANOCHO			
	Male (%)	Female (%)	Total (%)	sex Ratio	Male (%)	Female (%)	Total (%)	sex Ratio
0 - 11	30 (30.0)	18 (18.8)	48 (24.4)	1.7	4 (9.3)	4 (9.5)	8 (9.4)	1.0
12 - 23	22 (22.0)	21 (21.9)	43 (22.0)	1.04	10 (23.2)	10 (23.8)	20 (23.8)	1.0
24 - 35	17 (17.0)	14 (14.6)	31 (15.8)	1.2	6 (14.0)	9 (21.4)	15 (17.6)	0.7
36 - 47	12 (12.0)	21 (21.9)	33 (16.8)	0.6	11 (25.6)	8 (19.0)	19 (22.3)	1.4
48 - 59	19 (19.0)	22 (22.9)	41 (21.0)	0.9	12 (27.9)	11 (26.2)	23 (27.2)	1.1
0 - 59	100 (51.0)	96 (49.0)	196 (100.0)	1.04	43 (50.6)	42 (49.4)	85 (100.0)	1.02

3.2 Socioeconomic Characteristics

In both study areas, data on salient socioeconomic variables of families to which study subjects belonged, was collected. Summary of these variables is shown in table II. In all of these variables the two groups were comparable.

3.2.1 Religion :

Families covered by the study in Muketuri and Chanco were found to belong mainly to the Ethiopian orthodox church. Their proportion was 98.5 % and 96.5 % of them were christians, and the remaining 1.5 % and 3.5 % were all followers of Islam.

3.2.2 Ethnicity :

The predominant ethnic group, as was determined by the origin of the head of the household, was the Oromo. It was represented by 69 % and 63.5 % in Muketuri and Chanco respectively. The Amharas followed the Oromos by comprising 27 % in each of the study places. Other ethnic groups were only small minorities and constituted 4 % and 9.5 % in Muketuri and Chanco, respectively.

Table II. Comparison of house holds in selected variables in Muketuri and Chancho, July 1986.

Variables	MUKETURI (N=132) %	CHANCHO (N=85) %
RELIGION		
christians	98.5	96.5
Moslims	1.5	3.5
OCCUPATION		
Government emplyees	34.8	32.9
Trade	32.5	34.3
Dily labourers	11.0	13.1
'Palla'sellers		
Farmers	21.7	19.7
Jobless		
All others		
EDUCATION		
Illiterate	18.0	24.7
Read/write	49.0	51.7
Elementary	14.0	11.8
High school&above	19.0	11.8
INCOME(permonth-Virr)		
50	27.0	20.0
50 - 150	40.0	42.3
151 - 250	13.0	15.3
251 & above	20.0	22.4

3.2.3 Education :

Education of the head of households was categorized into four educational levels. Distribution was found to be comparable in both places. Illiterates, who neither write nor read for Muketuri and Chanco were 18 % and 24.7 % respectively a difference which was not statistically significant ($P > 0.05$). Family heads who were able to read and write through the literacy campaign comprised 49 % and 51.7 % in Muketuri and Chanco. Heads of households with education of elementary and high School level was 14 % and 19 % for Muketuri and 11.8 % for each level in Chanco.

3.2.4 Occupation :

The attempt to group heads of households into four occupational categories revealed that, nearly half of them in both study areas fall into the "other" occupational category. Further breakdown of this category resulted in fourteen different titles. For the purpose of this study, occupations of similar characteristics were lumped into four groups. Distribution of head of households into these groups is presented in table II. Comparison of heads of households in Muketuri and Chanco by different occupational groups, show no statistically significant differences.

3.2.5 Average monthly income :

Economic grouping of households is not as easy as grouping in other variables. However, for partial purposes, households were classified into four arbitrarily chosen economic groups. Difficulty is not only in grouping, but also in obtaining reliable responses and/or estimations on the income of a household, in which both cases require careful interpretation. In situations where the respondent failed to determine the monthly income, considering the living conditions of families, subjective, but genuine, estimations were made by the interviewer.

Results on this variable has shown that heads of household whose monthly income fall below Birr 50 were 27 % in Muketuri and 20 % in Chancho. Those who earn Birr 50 - 150 per month in Muketuri and Chancho were 40 % and 42.3 % respectively. Similarly, those with a monthly income of Birr 151 - 250 and above 250, were 13 % and 20 % in Muketuri, while in Chancho, it was 15.3 % and 22.4 %. Differences in each of the four groups were not statistically significant.

3.2.6 Water supply :

Water and sanitation are inseparable, and the health effects of these two variables is usually complementary. However, in this study, assumption was made on the similarity of the water supplied to people in Muketuri and Chancho.

In view of the potential confounding capacity of water, data was collected to assure the comparability of the study and control groups,

House holds in Muketuri and in Chancho get their water supply mainly from a deep well distributed through public stand pipes. At times of shortage, and technical difficulties of the pump, families fetch water from springs, rivers and unprotected individual wells. Quantification of water utilization pattern by a scoring system show similarity in both places. Summary of results on water supply is presented in table IV. Differences were of no statistical significance.

3.3 Excreta Disposal

3.3.1 Availability :

Latrine facilities were found to be available in 80.3 of the families visited in Muketuri. This coverage was nearly twice that of Chancho, which was only 42.2 %, significant at 99 % level of confidence ($P < 0.01$).

Availability of latrine facility was analysed by different socioeconomic characteristics of the head of the household. Analysis has shown that availability significantly increase as the income of the head of the house hold gets higher ($\chi^2=7.85$, 0.01 P. 0.05) .. Table IV shows the distribution of latrine facility by income groups of heads of house holds in Muketuri and Chancho.

Table III - Water supply in Muketuri & Chanco, July 1986.

Place of study	Utilizations as % of 'reference'* score	Average daily consumption in litres		Average daily cost (Eth. Birr)
		per family	per head	
Muketuri	76	68.2	11.6	0.10
Chanco	71.4	64.3	10.1	0.15

* See annex for reference score

Table 17. Availability of Latrine by Monthly Income in
Muketuri & Chancho, July 1988.

income	MUKETURI			CHANCHO		
group	N	number with facility		N	number with facility	
(Birr)						
50	35	27	77.0	17	2	11.8
50 -150	24	40	74.0	36	12	33.3
151 -250	17	15	88.0	15	8	51.5
250 ⁺	26	26	100.0	19	14	73.7
TOTAL	102	88	86.3	87	36	41.4

Analysis of availability by occupation and education of the head of the household shows no significant difference.

Availability of latrine was also analysed for motives that help households to own the facility. In Muketuri more than 60 % of the owners stated that they were imposed by the Kebele. On the Otherhand, ownership that resulted from educational advice from health workers was only 15 %. The remaining 24.3 % stated that the motive to construct their latrine was self initiation

3.3.2 Utilization and maintenance :

Latrine utilization and maintenance was determined on the basis of a scoring system designed to appraise utilization. Scores for each household was calculated and the mean utilization score for the study community and for that of the control was calculated, A ' standard ' score was set so as to serve as a reference for utilization and maintenance of the pitlatrine facility. Then, the proportion of utilization as compared to the reference score was determined for families in Muketuri and Chancho. Summary of results are shown in table VI.

All house holds who own a latrine facility were found to use it. However, usage in individual families was found to vary from one to another. Overall usage as shown in table VI.

Table V. - Availability of latrine by Motivating Factors
for Constructed, Muketuri, 1986.

Factors motivating Head of house holds to construct latrine	Number of house holds with latrine	
	Number	%
Imposition by ' Kebele '	66	61.1
Self initiation	26	24.7
Advise by health worker	16	14.8
TOTAL	108	100.0

Table VI. Latrine Utilization of Households
in Muketuri and Chanco, 1986

Place of study	Number of households with pit-latrine	Utilization as Percent of the reference
Muketuri	108	74
Chanco	36	74.5

was found to be deficient by about 25 % from the reference (standard) usage. It was also found that utilization of the latrine facility in Muketuri did not differ, from that of the control community in Chancho.

Analysis of utilization by certain variables of the head of the household has shown that, unlike availability, utilization seemed to have a direct relationship with education, but failed to show statistical significance.

Utilization was also found to have a direct relationship with the average monthly income of the head of the household. Analysis has shown that utilization was low in families whose income fall in the category of Birr 50, and it was seen to increase with income. As shown in table VII, each income category except those earning 50 - 150 Birr per month in Muketuri shows a significant increase in the utilization of the facility when compared with categories of lower income.

Utilization was further analyzed by factors that motivated the head of the household to construct latrine. Results revealed that those who owned the facility by their own initiation tend to utilize their latrine more than those who have latrines through imposition by kebele or advice by health workers. However, differences were not statistically significant.

Table VII. Utilization of pit - latrine by income of
the head of the house hold in Muketuri and
Chanco, 1989

Average monthly income (Birr)	MUKETURI			CHANCHO		
	N	% utilization	P	N	% utilization	P
50	27	44.0	2.1*	2	4.5	1.6**
50 - 150	40	1.5	1.3*	12	55.0	2*
151 - 250	15	71.5	5.5*	8	74.0	2.5*
250*	26	77.2	4.9*	14	75.2	2.9*
TOTAL	108	74.7		36	74.2	

* st. significant, at 0.05

** st. not significant at 0.05

3.4 Health Status

Assessment of health status in this study was using prevalence rates of the diarrhea, intestinal parasites, and protein - energy malnutrition. In addition, data on mortality of infants and children was supposed to supplement the morbidity data.

Results of each indicator is presented as follows :

3.4.1 Prevalence of intestinal parasites :

A total of 174 stool specimens from Muketuri and 75 from Chancho were collected, which made the response rate of 84.5 % and 79.1 % respectively.

Stool specimens were examined using Formalin - either concentration technique within 10 days after collection.

Results of stool examination for Muketuri and Chancho is presented in Table VIII.

In the present study, parasitological studies revealed that the overall prevalence of intestinal parasites in Muketuri and Chancho was 32.2 % and 56.6 % ($P < 0.01$)

As shown in the table, age distribution of study and control subjects especially the 0-11 months group, was seen as less comparable and the need for age adjustment was felt. The age adjusted prevalence rate was then found to be 49.2 % for Chancho taking the rate for

Table VIII. Distribution of intestinal parasites in Muketuri and Chancho, 1986.

Age group in months	MUKETURI			CHANCHO		
	N	Positives	%	N	Positives	%
0 - 11	42	4	9.5	7	4	50.0
12 - 23	36	15	41.7	17	3	15.0
24 - 35	31	6	19.3	13	8	53.3
36 - 47	30	13	43.3	16	10	52.6
48 - 59	35	18	51.4	23	18	78.2
TOTAL	174	56	32.2	76	43	56.6

Muketuri as it was. The result was still statistically significant at 99 % confidence level ($P < 0.01$).

A total of seven species were identified in the present study. *Ascaris lumbricoids* was the most prevalent in both of the study places, 44 % in Muketuri and 40.0 % in Chancho. *Enterobius vermicularis* and *strongyloids stercorarius* were the least, and hook worm and *Taenia* species were not identified at all.

Distribution of identified species in Muketuri and Chancho is presented in Table IX.

Multiple (or mixed) infections were also found to be common in Chancho than in Muketuri Comparative summary is given in Table X.

The most commonly seen partnership was between *Ascaris* and *Trichuris*. *Ascaris* was found in seven of the eight type of combinations observed.

Positivity was analyzed by availability and utilization of latrine. But, results in general failed to show significant differences between subjects belonging to families with and without the facility.

Among other variables that positivity was analysed by, income to the head of the households shown some degree of relationship to positivity of the child, but of not statistical significance.

Table 14. Distribution of parasites by species, Muketuri
and Chancho, 1986.

Species	MUKETURI		CHANCHO	
	Number	%	Number	%
<i>Ascaris</i> L.	26	44.0	24	40.0
<i>Hardia</i> L. (cyst)	17	32.2	11	18.3
<i>E. discoidea</i> (cyst)	5	8.3	5	8.3
<i>Sympterna</i> L.	4	6.6	10	16.7
<i>Trichouris</i> L.	3	5.0	7	11.7
<i>Entropius</i> L.	1	1.7	-	0.0
<i>Strongylus</i> L.	1	1.7	2	3.3
All parasites	67	100.0	61	100.0

Table X. Multiple parasitic infections in Muxeturi
and Charcho, 1985.

Infection with	M U X E T U R I		C H A R C H O	
	Number	%	Number	%
Single species	55	94.0	29	67.4
Double "	3	5.4	11	25.6
Triple "	-	-	3	7.0
TOTAL	58	100.0	43	100.0

3.4.2 Diarrhea :

Determination of diarrhea of subjects was by two-weeks recall interview of the mother or the guardian of the child. As shown in table XI, prevalence of diarrhea was higher in the controls than the study groups in Muketuri. However, the difference was not statistically significant ($Z = 0.08$, $P < 0.05$).

Occurrence of diarrhea was analyzed for factors such as availability and utilization of latrine and other socioeconomic variables of the family, but results did not appear to be of any statistical significance.

3.4.3 Prevalence of protein - energy malnutrition :

Anthropometric measurement of subjects and controls was analyzed using Waterlow's method of classification(70). As shown in table XIII, only 54.6 % of subjects and 40 % of controls were found to be normal. The remaining ones were either wasted, stunted or under-weight. The overall prevalence of protein - energy Malnutrition was higher ($\chi^2 = 8.21$, $0.01 < P < 0.05$) among controls than subjects. Wasting and stunting combined, were also significantly high among children in Chancho, But there was no statistical difference among stunted children in both study areas.

Table XI. Two-weeks recall period prevalence of
Diarrhea in Muketuri and Chancho, 1986

Place of study	Number of subject	Number with diarrhea	Percent positives for diarrhea
Muketuri	196	23	11.7
Chancho	85	13	15.3

Table XII. Cross translation of Height - for - age and weight - for - age
 weight at cut - off of - 2SD from median of the reference
 WHO African region
 for Mauritius and Madagascar, 1990,

MAURITIUS

height - for - age

-2SD	-1SD	0	1SD	2SD
111	117	122	127	134
114	120	125	130	137
117	123	128	133	140

weight - for - height

MADAGASCAR

height - for - age

-2SD	-1SD	0	1SD	2SD
111	117	122	127	134
114	120	125	130	137
117	123	128	133	140

weight - for - height

Table XIII. Percentages of Children with Stunting, wasting, and Stunting and wasting in Muketuri and Chancho, 1986.

Status	MUKETURI		CHANCHO		P Value
	N	%	N	%	
Normal	107	54.6	34	40	2.5 *
Stunted	62	31.6	29	34.1	0.38 **
wasted	21	10.7	16	18.8	2.25 *
stunted + wasted	6	3.1	6	7.1	2.0 *
TOTAL	196	100.0	85	100.0	

* Statistically significant, P 0.05

** Statistically not significant, P 0.05

4 - D I S C U S S I O N

The growing awareness of the importance of improved sanitation is reflected by the effort many countries, including Ethiopia, are making to implement the primary health care and sanitation decade's programs. The role of sanitation on health and development can still be further realized by understanding the mechanisms of its impact on the health of communities.

Understanding the impact of sanitation has proved difficult due to not only the complexity of health and sanitation, but also due to lack of clear and uniformly applicable methodology (14, 65). Health indicators available for measuring the intricate characteristics of sanitation are also less accurate and indicators capable of doing the task are lacking.

In the absence of baseline data, the present study, with the objective of determining health effects of pit-latrines intervention, selected a control community. In view of the impossibility of obtaining identical communities for comparison, an attempt was made to control major socio-economic variables. The presence of other change producing factors were in addition assumed to operate similarly in both communities.

The prominent differences between the study and the control communities, indeed beyond the capability of this study to act upon, were the size of the population and the health service facility.

The population of the control community was nearly twice that of the study population. This may mean that, the larger the population, the higher the chance of fecal accumulation and the higher the possibility of developing fecal-borne diseases. The crowding index of the studied households were however, close to each other, 5.8 and 6.2 persons per family in Muketuri and Chancho respectively.

On the other hand, the presence of a health center in the control community may have a different impact to that of the health station in Muketuri. Earlier studies (78, 79) that assessed the impact of health centers in Ethiopia, revealed that health centers do very little or nothing to decrease the transmission of fecal-borne diseases. Except for differences in the size and quality of staff, weekly service programs are more or less the same in both places. In as far as possible an effort was made to control the quality of the data.

In addition, since data collection procedures were consistent in both study areas, error's that might have been involved unnoticed were common to both groups of populations studied.

Interpretation of results should therefore be cautiously made in respect to shortcomings of this study.

The study in general, as evidenced by higher rate of responses, was acceptable in the study and control communities. The response rate obtained in Muketuri and Chancho was 95.6 % and 90.4 % of subjects, and 97.8 % and 93.4 % of households respectively.

Non-responses in both of the places were due to unavailability of the family throughout the period of data collection, in which, there was nothing to do about it except repeated visits until the last day of data collection.

4.1 Availability of pit latrine

Availability of pit-latrine in the households visited was 81.8 % in Muketuri against 42.4 % in Chancho. This result verified the success of the 1981 campaign of pit latrine provision in Muketuri. Even though the claim made by then was full coverage, the present finding is still very high, for no report in the country has so far been made of such a coverage level. In view of the present sanitation coverage status (28 - 31) and the plan being implemented (27), the achievement of Muketuri through a campaign of short duration will be a valuable source of lessons and experiences. In addition, in spite of continued efforts of health workers for the last two more decades, such a coverage level has not been reached. To learn and understand from the experience of Muketuri, would therefore be of great value.

The role of the community and mass organizations in the promotion of its own health has already been stated (9). The "Kebele " in Muketurin did testify to this fact, in which it somehow enabled 60.7 % of the households to own latrines. However, the mechanism needs further investigation, since households reported the facility was imposed rather than having been involved in the process of owning latrines.

The close inter-relationship between sanitation and the socio-economic status of a community has been described time and again. New concepts have also evolved to clarify these relationships. Shuval et al (66) have proposed their "threshold - saturation" theory explaining that the socioeconomic situation has to be improved to a certain level below which sanitation improvement is minimal. Availability of latrine facility in Muketuri was shown to be directly related with the average monthly income of the head of the household. This suggests that improved sanitation requires an extra effort in addition to what is being done by health workers alone.

4.2 Utilization of pit - latrine

Mere provision of sanitary facilities without the assurance of its utilization was indicated as having little or no effect on health (65, 80, 81). This has been demonstrated in Brazil (41), after providing thousands of pit latrines into a rural community, it was later identified that they were unused pits. In Muketuri, all available latrines were found to be in use. However, the degree of usage was not adequate and was not different from that of Chanco indicating that 1981 campaign did not include "utilization" as part of the excreta disposal entity. Had the campaign integrated the effort to enable everyone to have a latrine, with educating the community on the benefits of proper excreta disposal, the usage pattern would have grown along with growth in availability. The role of health workers during such types of campaigns should focus on this aspect as well.

Economic betterment of community members is an important factor in the process of improving the environment. The Muketuri study has shown that, income of the family not only is a factor for availability but also for utilization. Among all other characteristics of the family, the income was the only one to be found related with both availability and Utilization of pit latrines, which coincides with other studies (81).

An increased level of utilization was found among households who constructed latrine on their own initiation than those who built through the imposition by the 'kebele ' or through information from health workers. Though, self-initiation as such requires further analysis the results verify the fact that for any health practice, the behavioral change of the community is essential. The input by health workers has to be comprehensive, so that community members will be able to do what they are told to.

However sensitive the health indicator is used, the impact of proper human waste disposal on health cannot exactly be measured (65). However, valuable information can still be generated from studies designed as carefully as possible. Analysis of morbidity reduction is the most commonly used instrument of assessing the impact of health programs, such as the intervention introduced into Muketuri.

4.3 Intestinal Parasitism

The prevalence of intestinal parasites has been used to indicate the level of fecal contamination of the environment. The transmission of intestinal parasitic diseases involves a complex interaction between the host, agent and the environment. Provision of excreta disposal facility greatly reduces the transmission of these infections (39, 40, 41) but are not a panacea by itself, for the fact that intestinal parasitism results not only from inadequate sanitation but also from the sociocultural situation of a given community.

Intestinal parasites in Muketuri was found to be relatively less prevalent than in Chancho, 32.2 % versus 56.6 % respectively. The age adjusted rate for Chancho was also 49.2 % ($P < 0.01$). The higher rate of multiple infection in the controls than in the subjects further supports the hypothesis made in this study. The difference in the population density between the two communities requires consideration, since transmission of parasitic infections may be enhanced by fecal accumulation in densely populated areas. However, the crowding index between the two places is more or less similar. The index determined from the studied families, was 5.73, persons per house hold in Muketuri while it was 6.28 for Chancho.

The failure to demonstrate reduction in positivity among subjects from facility owned families, could either be due to inadequate utilization of the facility or probably, protection of

individuals may not be fully attained unless the overall environment is protected from contamination, or due to both. It has already been indicated by Feachem et al (82) in their investigations in three African countries, that provision of superior water and sanitation facilities to small clusters of houses scattered through an area, was not protective to those families. This however, demands further studies on large population set ups.

4.4 Diarrheal Diseases

The use of diarrheal diseases to indicate the status of environmental contamination, or the level of excreta disposal is of paramount importance. Several studies have been carried out, using diarrhea as a yardstick for excreta disposal status.

However, diarrheal diseases lend themselves to multiple causal factors, and are not the best indicators. In addition, in studies such as the present one, determination of diarrheal episodes using the recall interview of the mother or the guardian underestimates the true picture of diarrhea. Choice of optimum recall period, is of particular interest since the longer the period the greater the tendency of under-reporting of symptoms (83, 84).

Using two-weeks recall period, the prevalence of diarrhea in Muketuri was less than that of Chancho, though not statistically significant, showing an improvement over the controls. Despite the over all reduction in prevalence failure of analysis to reveal the relationship between diarrhea occurrence and facility availability

on individual children may be explained similarly as was for intestinal parasites. In general, diarrheal studies should be either prospective or using shorter recall periods.

4.5 Nutritional Status

Studies done else where have shown the effect of improved sanitation on nutritional status of populations (40, 48). The nutritional status of children in Muketuri and Chancho, as measured by anthropometric indicators, show that there exists a high prevalence of undernutrition in general. However, the relative improvement of nutritional status observed in Muketuri over their counterparts in Chancho, deserves attention. The prevalence of wasting and wasting with stunting is significantly higher in Muketuri. The two indicators reveal the present conditions nutrition of the community (71, 73, 85). Classification of nutritional status, using Waterlows method (73) has shown improvement over the findings in Chancho. An earlier finding by Mekonen and Zein (86) on pre-school children has shown rates comparable to that of Chancho, in which only 43 % and 40 % of the population studied were normal. In Muketuri, 54.6 % of the population were found to fall in the " normal " category.

5 - CONCLUSION & RECOMMENDATIONS

The importance of sanitation as an essential component of public health, has been noted by health professionals and concerned government bodies for a long time.

In view of the long term effect on the general socioeconomic development, and its short term effect on specific health problems, sanitation deserves priority.

The present study has shown the effect of proper excreta disposal on the health of the community in general and on pre-school children in particular.

The results of this study provides foundation for researchers, and consequently for planners and health administrators. It gives a clue on the factors involved in the availability and utilization of pit - latrine facility.

Health campaigns, like that of Muketuri's should be planned, rather than being spontaneous, so that its continuity could be maintained. If it is planned, and involve all concerned including the community, out comes may be rewarding.

The role of the community as both beneficiary and as contributor in health campaigns, should be clearly understood not only by the community, but by organizers of campaigns and health workers themselves.

The interaction of sanitation and health with the socioeconomic status of a given community, indicates that health is no more the responsibility of the health sector alone but of all concerned in the overall development of communities. This suggests, that such type of mass campaigns, should also aim at other variables of development.

Better understanding on how sanitation affects health is dependent on accurate informations available. Thus , the data collection system by concerned government agencies especially by Ministry of Health, should be strengthened.

Research forms the fundamental basis for planning, decision making and policy formulations.

The effort to improve the health of community requires scientific knowledge on the real needs of the community itself. Thus research should be part and parcel of all health programmes.

If plans are to be effectively implemented, and if the objectives set are to be achieved, the will and commitment of the government has to be transformed into actions and practices. Environmental health activities. like any other health programs deserves the support of the Government, so that the goal "Health for All " will be reached.

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83 =

A N N E X

[illegible]

Observation by the interviewer

Location of latrine (distance from dwelling, water source, kitchen.... etc) properly located _____
poorly located (hazardous) _____

Superstructure (walls, roof, floor, privacy.. etc) good _____ fair _____ poor _____

Squatting hole has cover yes _____ no _____

Total score for availability _____

UTILIZATION & MAINTENANCE

1. who uses the latrine ? all members _____
males only _____ females only _____

2. if users are males or both sexes do not share females, why ?
males can go for field defeca. _____
males stay out for work and defecate there _____
no reason _____
other reason, specify _____

how many of the times is the latrine used ? always _____ mostly _____
rarely _____

if used always, why ? no other place to defecate _____
fear of penalty _____
because others do it _____
convenient _____
because feces is dangerous _____
no known reason _____
other, specify _____

if used rarely, why ?
 bad odour & dirt _____
 open field is convenient _____
 stay out for work all days _____
 no pri privacy _____
 Other, specify _____

what time of the day
 is preferred to use the
 latrine ?
 early morning _____
 mid-days _____
 late-evening _____
 as necessary _____

what are your opinions
 on benefits of latrine
 use ?
 good family health _____
 good child health _____
 clean living environment _____
 convenient than going for
 field _____

Observation by the interviewer

does the track to the
 latrine indicate its being
 used if covered with grass ?
 yes _____ No _____

is the hole covered ?
 and the floor ?
 Yes _____ No. _____
 clean _____ dirty _____

quantity of feces in
 the pit, in relation to
 are of it. depth,
 number of users
 so tests
 its use currently _____
 used previously _____
 not used _____

feces in the compound
 seen _____ not seen _____

data were for utilization

IV. WATER SUPPLY

1. source	River _____	spring _____
	Well _____	pipe _____
2. distance	Less than 15 min _____	15-30m _____
	30 - 60 m _____	1 hour _____
3. any payment	Yes _____	No _____
if yes, how much	cents per pail, jug, or any other unit _____	
how much do you spend/day ?	_____ cents	

Observation by the interviewer

4. water storage at home.	clean container & covered _____
	clean but not covered _____
	dirty container & uncovered _____
5. water usage at home	hygienic _____
	unhygienic _____
6. amount of water consumed by family per day.	_____ litres

V. ANTHROPOMETRY

Child code number	age	sex	ht. in cm.	wt. in kg.	arm- circumference in cm.

Weighted score allocation for
latrine utilization and maintenance

a)		Response	score	%
	A. Availability	Xes	14	35%
	B. Utilization		26	65%
	1. number of family members using the latrine	All	2	
		males only	1	
		females only	1	
	2. if users are males of females Why ?	males stay out for	2	
		work both sexes do	1.5	
		not share males		
		cango for field		
		defecation	0.5	
		no reason	0	
	3. how many of the times is it used	always	2	
		mostly	1	
		rarely	0.5	
	4. if used always, why ?	Knowledge on fecal hazardness	4	
		convinient to use latrine	3	
		fear of penalty	1	
		becayse, others do	1	
		no reason	0.5	

	Response	Score	%
Utilization (contd.)			
5. if used rarely, why ?	Stay out for work all day	2	
	no privacy	2	
	bad odour & dirt	1	
	open field is convinient	0.5	
6. What time of the day . is prefered for using the latrine	every morning	2	
	mid-day	2	
	late evening	0.5	
	as necessary	2	
7. What are your opinion on the benefit of latrine	good family health	2	
	good health for children	1.5	
	clean environment	1	
	convinient than field	1	
8. does the track to the latrine indicate its being used?	Yes	2	
	No	1	
9. is squatting hole covered	Yes	2	
	No	1	
and the floor ?	Clean	2	
	dirty	1	
10 quantity of feces in the pit-indicate	its use currently	2	
	used previonsly	1	
	not used	0	
11 Feces in the compound	not seen	2	
	seen	0.5	

Weighted score for water utilization

	Response	Score	%
Water supply		10	100
1. Source	river	0.5	
	spring	1	
	well	1.5	
	pipe	2	
2. Distance	15 min walk	2	
	15 - 30 min walk	1.5	
	31 - 60 min	1.0	
	1 hour	0.5	
3. Any Payment	Yes	1.0	
	No	2.0	
4. Water storage at home	Clean container covered	2	
	clean container uncovered	1	
	dirty container	0	
5. Water usage at home	hygeinic	2	
	un-hygenic	1	

DECLARATION :

I, the undersigned, declare that this thesis
is my work and that all sources material
used for the thesis have been duly
acknowledged.

Name : Zenaw Adam.....

Signature : Zenaw.....

Place & date of submission

Addis Ababa University Sep, 1986,