Department of Community Health,
Faculty of Medicine,
Addis Ababa University

Assessment of the Effect of Nutritional Status and Intestinal Parasitic Infection on Academic Performance of Elementary School Children in Teda Town, Gonder, Ethiopia.

By Belete Abebe, MD

A thesis submitted to School of Graduate Studies of Addis Ababa University in partial fulfilment of the requirements for the Degree of Master of Public Health

December 2000.

Department of Community Health

Faculty of Medicine

Addis Ababa University

Assessment of the Effect of Nutritional Status and Intestinal Parasitic Infection on Academic Performance of Elementary School Children in Teda Town, Gonder, Ethiopia.

By Belete Abebe, MD

A thesis submitted to School of Graduate Studies of Addis Ababa University in partial fulfilment of the requirements for the Degree of Master of Public Health.

Advisors

Fikru Tesfaye, MD, MPH

Misganaw Fentahun, MD, MPH

December 2000.

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Assessment of the Effect of Nutritional Status and Intestinal Parasitic Infection on Academic Performance of Elementary School Children in Teda Town, Gondar, Ethiopia

By

Belete Abebe, MD

Department of Community Health
Faculty of Medicine, Addis Ababa University

Approved by the Examining Board

Dr. Yemane Berhane **Chairman, Department Graduate Committee**	
Dr. Fikru Tesfaye **Advisor**	
Prof. Bernt Lindtjorn **Examiner**	
Dr. Alemayehu Worku **Examiner**	

DEDICATION

TO MY FAMILY

Acknowledgment

First of all, I want to give my heartily thank to my advisors Dr. Fikru Tesfaye and Dr. Mesganaw Fentahun for their unlimited efforts for the accomplishment of this thesis work.

I owe much to Dr Yemane Berhane, head of the Community Health Department, for his valued and decisive methodological guides during data analysis.

I also extended my gratitude to the librarians of World Health Organization (WHO), United Nations Childrens' Fund (UNICEF), Institute for Curriculum Development and Research(ICDR), and Ethiopian Health and Nutrition Research Institute (EHNRI) for their important help in the search of some valuable references and permitting me to take out such materials for photocopy.

The list contains many to whom I would like to thank including Dr. Alemayehu Worku (biostatistician), the study team, school personnel, Teda health center workers, computer Lab. workers Ato Negusu Worku, and Ato Wondwesen Bekele etc. all directly or indirectly had contributed to this research work.

Table of content

Page

List of table **Page**

List of abbreviations

CI - Confidence interval

E.C.- Ethiopian calendar

EHNRI - Ethiopian Health and Nutrition Research Institute

G.C. - Gregorian calendar

ICDR - Institute of Curriculum Development and Research

IDA - Iron deficiency anemia

IDD - Iodine deficiency disorder

HAZ - Height for Age Z-score

IP, IPI- Intestinal parasite, Intestinal parasitic infection

Lab. - Laboratory

MN - Malnutrition

NCHS - National Center for Health Statistics

OR - Odds ratio

PEM - Protein energy malnutrition

SD - Standard deviation

SES - Socio-economic status

Techn - Technical

UNICEF - United Nations Children's Fund

WAZ - Weight for Age Z-score

WHZ - Weight for Height Z-score

WHO - World Health Organization.

Abstract

A cross sectional study was conducted involving 641 students of the two primary schools of Teda town, North Gonder. The purpose of the study was to determine the nutritional and intestinal parasitic infection (IPI) status of the children, the effect of IPI and nutritional status on the children's academic performance, and the effect of IPI on nutrition. Data were collected using questionnaire and anthropometric measurements. Physical and stool examinations were also carried out. School average scores were obtained from school records. The data were entered, processed and analysed using EPI Info version 6, computer software (and its subprogram EPINUT). Underweight and stunting were found to be 59.8% and 41.7% respectively, whereas the overall IPI rate was 77.7%. The commonest infection was Ascaris lumbricoides with prevalence of 66.7%, followed by Entameba histolytica with prevalence of 14.8%. Low than high pupils' school average score was significantly associated with underweight, $X^2 = 39.45$, (p value < 0.0001), and with stunting, $^2X = 19.79$, ($p < 0.001$). Intestinal parasitic infection did not show any association with the nutritional status and school performance of the children. A higher proportion of the younger than the older age group was underweight, OR = 1.86 (95% CI = 1.32, 2.64). Also higher proportion of the urban students than that of the rural ones were underweight, OR = 2.25 (95% CI = 1.59, 3.18), and a significantly higher proportion of the urban than the rural students were stunted. The town and the rural students were not different regarding to IPI. This survey should sensitize concerned bodies for improving primary school children's health and nutrition. Recommendations are made to take actions to alleviate the IPI and nutritional problems of the school children.

1. Introduction

1.1. Background review

School children need to be healthy and well nourished, in order to be content and learn better. School children constitute around 1/4 of the total population of a nation and they are the future productive forces. These children are vulnerable to nutritional deficiencies and debilitating effects of intestinal parasitic infections. So they need more attention and care (1, 2).

Infectious communicable diseases and nutritional problems are causing about 60-80% of the health problems in Ethiopia. Helminthiasis is among the leading causes of medical consultation in the country (3).

Intestinal parasitic infections (IPIs) are very common with highest intensity in school age children. These include ascaris, hookworm, and whipworm. They affect educational achievement of school children directly as ill health or through their negative effects on nutrition (4-7).

Both nutrition and education have relationship of mutual influence. Education helps to improve nutrition, and improved nutrition is necessary for physical (including brain) growth and development (6-10). Shortage of nutrients for formation (building) in chronic undernutrition could lead to stunting, and cognitive developmental delay. Because of energy shortage, acute or chronic protein energy malnutrition (PEM) also reduces cognitive functions

or school performance. Better nourished children show a greater attention and learning capacity than malnourished children (6, 9-14). Undernutrition acts synergistically with poor socio-environmental factors to affect negatively cognitive development of a child. The developmental lag of a student could be reversed if a remedial feeding alone or better combined with psychosocial or environmental stimulation (enrichment) is provided (9-12).

Good health as good nutrition is a key factor to attend school, continue education, and achieve high educational performance. Education to be effective needs good health. On the other hand, increased levels of education of an individual are positively associated with his/her increased work capacity and income, decreased fertility rate, improved nutrition status and family health, and favorable tendency to modernization (6-10). Therefore, health is affected negatively by nutritional deficiencies, IPI, and poor education. And poor health hinders education (4, 6, 8-10).

Health, nutritional, educational, economical, and socio-political benefits can be gained from investment in school health including improved nutrition promotion (6-7).

The causes of each problems are multiple and their solution needs a multifocused and multisectoral effort. School feeding programs, and deworming can serve as short term solution. The long term solutions are socio-economic development and eradication of poverty. Also the long term solution includes improved community hygiene, safe and adequate drinking water supply, health service access, and improved nutrition (4-8, 10, 15-16).

1.2. Statement of the problem.

Nutritional deficiencies, and IPI are threats for the health and education of school children (6). Data are scarce regarding magnitude of PEM, and its effect on school performance in Ethiopian school children. The same is true regarding the effects of IPI on PEM and school performance of the children. The effects of socio-demographic factors on PEM, and school performance are also not studied in the primary school children. Such effects vary much with place (even within one zone), person and time. They need to be studied because they are very important for children's health and school performance. The need to have baseline data on these issues (questions) is one of the reasons for this study. It has important policy implication regarding health and nutrition promotion through school for better life as a continuity of care from preschool to school children.

2. Literature review

2.1. Magnitude of the problems

A. Malnutrition

World wide, PEM affects about 1/2 billion children (4, 17). And in Africa, in 1982, 35-70% of Tanzanian children were found stunted (18). More recently, in rural Ejisu-Juabe district, Ashanti Region (Ghana), among the 886 primary school children aged 5 years- 9 years old, wasting and stunting were found 44.4% and 54.9% respectively (19). Out of the total 62.7% anemic primary school children of Kenya, 50.3% were found with iron deficiency anemia (IDA), which was 78% due to hookworm and 20% of it was of severe form (17).

Data are scarce on prevalence of PEM, and IDA in primary school children of Ethiopia. In Sidamo region, in post harvest season, 27% of the primary school children were stunted, and 6.7% were both stunted and wasted, and in preharvest period stunting was 74%, and both stunted and wasted were 16%. And in Gondar, the caloric intakes of children were found 80% of the Recommended Daily Allowance (20). Nutritional anemia was 18.4% in the general population (3), and the prevalence of anemia in children aged 6 months upto 6 years in Gonder was 47.2%, in 1987 G. C. (21).

B. Intestinal parasites

Ascaris, hookworm, and whipworm affect more the school age children than the adult population. Contrary to Enterobius vermicularis, strongyloides is nutritionally important but is less prevalent (2, 22, 23). The prevalence of ascaris, hookworm, and whipworm were found 17%, 12.4%, and 28% respectively in Kampala (24), and 49%, 82%, and 92% respectively in rural Kenya (25).

In the central and northern part of Ethiopia, in 1976, the prevalence of ascaris infection in primary school children was ranged from 9% to 98% (26). Also in Addis Ababa primary school children, it was 50% in 1968 G.C. (27). Necator americanus infection is found mostly in humid lowlands of Ethiopia (28). A study in Asendabo, Omo-Nada woreda (Jima), 1^{st} - 8^{th} grade students, the prevalence of Ascaris, hookworm and Trichuris were 56.4%, 25.5% and 21.6% respectively (29). Whereas in North and South Gonder primary school children, the prevalence of ascaris, hookworm, and T. trichiura were 29%, 15% and 15% respectively in the

high lands; 35%, 15%, and 24% respectively in the temperate lands; and 38%, 15%, and 24% respectively in the lowlands (30).

2. 2. Causes of the problems

PEM, IPI and poor school performance of a child are determined by the interactions of multiple and complex factors (7, 31-37). The syndrome poverty is their root cause which is deprivation of the basic human needs. Its elements include ignorance, harmful traditional practices, underdevelopment of agriculture, unemployment, unsanitary environment, inadequate and unsafe water supply. Overcrowding, child care deprivation and poor woman status, poor health service access are also manifestations of poverty (4, 34, 36-41).

2.2.1. Determinants of undernutrition

PEM is caused by a complex, and multiple interrelated factors (1-2, 4). These causes of PEM can be classified as immediate, intermediate and basic causes. The basic causes produce the intermediate causes which in turn causes the immediate causes of PEM (10, 34). In developing countries, the main immediate causes are inadequate dietary intake and infectious disease. Both have a synergistic interaction. PEM decreases host resistance to infection by decreasing cellular and humoral immunity (34, 42). On the other hand, the infectious diseases which include measles, tuberculosis, infectious diarrhea, whooping cough, malaria predispose the host to further infection by depressing cellular and humoral immunity. And these infections including IP infection cause PEM by various mechanisms including the following:

1. decreasing intake of nutrient due to anorexia and vomiting.

2. increasing metabolic rate and nutrient need for nutrient wastage, fever, and others.
3. decreasing alimentary secretions and absorption.
4. increasing nutrient wastage due to diarrhea.(31, 34, 36, 42).

Inadequate household food security is one of the underlying factors for PEM. Its main determinants are ignorance, disasters and unfavorable agro-ecological environment. Low inputs into the eroded infertile soil, lack of high yielding variety of seeds and livestocks coupled with drought, crop pests, and population increase are also factors for food shortage (34). Cultural taboos, inadequate food storage, and processing are reasons for food shortage (36, 38). Unfair intrahouse food distribution among family members is another cause of undernutrition , for e.g., in Ethiopia, women and children eat last and the least food (34).

Inadequate child and maternal care is a second underlying factor for malnutrition. Mother's low status and insufficient time to care many short-spaced children predispose the child to disease and inadequate dietary intake. In case of illness, the sick child gets inadequate care and feed. Thus a mother who does not have the necessary resources and social support is a risk factor for undernutrition, IP infection and poor cognitive development of the child (34-38, 43)

A third underlying factor for undernutrition is inadequate health service and unsanitary environment. The unavailability or nonuse of primary health care services are contributory factors for PEM, since such services could prevent or rehabilitate PEM (34, 36, 38, 43).

There is an interaction among the three underlying causes of undernutrition. Inadequate household food supply forces the mother to work more hard to secure food. This worsens her workload and decreases more her time to care the child resulting in child undernutrition and infection. As a result the inadequate household food supply is worsening by taking the mother's time to care the sick child. Since there is no resource, the malnourished child is less likely to use the health service and get sanitary environment which in turn compromise their nutrition (34, 36-38, 43).

The possession and control of resources by an individual or a community are determined by the national and international order of economic structure and politico-ideological superstructure. The developing countries exchange their raw products cheaply for expensive industrial products from developed countries. As a result of socio-economic injustice, either nationally or internationally, a vicious circle is created in which poverty as a root cause produces undernutrition and infection which in turn lead to poor physical and mental development. Thus, the poor are less productive and becoming more poorer and underdeveloped (34, 36, 38-41).

Negative effects of undernutrition on brain or physical development depend on the duration, severity, timing of occurrence and corrective measures. An ongoing PEM, in acute or chronic form, decreases the physical activity and mental functioning of an individual due to energy shortage. Chronic undernutrition produces stunting in a growing child and mental retardation in early childhood. Early starting of adequate feeding and care for the undernourished child

could reverse brain damage (7, 31, 35, 37, 44-47).

IDA is mainly due to hookworm infection (blood loss) in children, and to a lesser extent due to inadequate dietary iron intake (poverty). Chronic IDA, and iodine deficiency disorder (IDD) in severe form lead to reduced physical and brain development (4, 10, 32, 37, 48).

2.2.2. Determinants of IPI

IPIs are the main factors in PEM by causing or aggravating it (1-2, 4, 31). IP infection is acquired and transmitted by the interaction of human host and environmental (including the agent IP) factors. In developing countries, the majority of the populations live overcrowded, without having basic sanitation and they defecate on the open field and contaminate the environment. They are the agent of spread and victim of IP infection (32, 49-50).

For their high prevalence and nutritional importance in primary school children, only the 3 commonest soil transmitted nematodes namely ascaris, hookworm and trichuris (4) are described.

Infected persons with IP contaminate the soil by defecating on the open field. Thus, the human host gets IP infection from the IP eggs/larvae contaminated soil. Infected persons are reservoirs for adult IP, while the soil is reservoir for eggs/ larvae of IP. The type of soil, and temperature (or climate) determine the survival and development of the eggs or larvae. Eggs of ascaris and trichuris need temperate climate, shaded, moist, oxygenated and hard clay soil,

whereas hookworm eggs/larvae need warm, moist and oxygenated soil and a sub/tropical climate. Flat areas with sandy clay soil are needed for Necator americanus. Well drained and sandy loams on slopes are needed for Ancylostoma duodenale (28, 32, 49-51).

Once the eggs or larvae have completed their developmental stage in the soil they are capable of infecting a person if exposure or contact is occurred. Larva of Necator americanus is acquired exclusively by skin penetration, whereas the larva of Ancylostoma duodenale is acquired by skin penetration and ingestion. And infection of ascaris or trichuris is occurred by the ingestion of the parasite eggs. Such ingestion is occurred when the child eats with the unwashed and contaminated hands or drinks contaminated water. Or when she/he eats unwashed and uncooked contaminated food, since excreta used as fertilizer or improperly disposed contaminates vegetables or crops (2, 8, 52-53).

Children are at more risk to IP infection due to their frequent hands contact with contaminated soil and less awareness of hand washing practice before eating. Infection is peaked between 4-18 years due to increased exposure with age. Then infection is maintained constant possibly due to host resistance development and habit modification, i.e., less exposure. But there is no development of permanent protective immunity to reinfection. Immunity seems to limit intensity and severity of infection (32, 36, 38, 49-54).

IPs affect more certain households due to specific behaviors of such families, either they are

unaware of prevention of IPI or are poor to get rid of IPI by getting treatment. Or they do not use or use improperly the available latrine. Such families perpetuate the infection transmission by contaminating their houseyard. Also the poor hygienic practices of food handlers in public catering and their inadequate supervision play a role in IP transmission (36, 52).

IPIs produce anorexia, vomiting, diarrhea, abdominal pain, nutrient wastage, blood loss, itching, easy fatigue, insomnia and irritability. Some of which are reasons for undernutrition and poor school performance. Intensity and severity of IPI are more pronounced in undernourished child, possibly due to immunity depression by PEM. The depressed immunity facilitates invasion by other infection (1-2, 4, 22, 32, 49-55).

2.2.3. Determinants of school performance

Learning ability (intelligence) of an individual or a child is determined mainly by the interaction of the child genetic (nature) and environment (nurture). The function of the brain is influenced by the psychosocial environment (nurture). Good nutrition, health, and psychosocial conditions are needed for normal growth, and cognitive functioning of the brain (7, 31, 35, 37, 46-48, 56).

PEM, IDA and IPI are causes of poor physical and intellectual development and school performance (1-2, 4, 33, 35, 37). An undernourished child is less likely to get optimal maternal care (as explained previously in PEM section) which is necessary for mental development. The poor mother and the impoverished environment provide little for the child

to explore and have optimal development. The child is more likely to be abused and to have low self-esteem, and poor personality and cognitive development (4, 7, 33, 35-37, 43-47, 56).

Therefore, school performance of primary school children depends on their health, past and present nutrition and developmental status. Past nutritional deficiencies including PEM, IDA and IDD affect the brain and as a result affect school performance. Present PEM and IDA also affects school performance due to energy shortage (7, 9, 31, 33, 35, 37, 56). IPI as disease and cause of undernutrition lead to poor school performance (4, 7). The child's socio-demographic factors also determine his/her academic success (35). The child's workload for income, educational material shortage and lack of support and supervision hinder his/her school performance. So do child's interactions with peers and teachers. The child's attitude towards education, and his or her motivation to achieve coupled with efforts to learn contribute to the academic results (34-36, 56).

2.2.4. Study evidences

Pollitt et. al. had studied two groups of 600 people, aged 11 years - 27 years, in 4 villages of Guatemala from 1988 to 1989. One of the group was from two villages and had received Fresco (sweet drink with no protein) Supplementation from 1969-1977. The other group was from the rest other 2 villages and had received Atole (hot maize gruel rich in protein) Supplementation also from 1969-1977. Each group had received the supplementation prenatally and for at least 2 years after birth. The supplementation study participants were pregnant woman, and children under the age of 7 years. Literacy, vocabulary, arithmetic and

a standard non verbal intelligent tests were administered to the study population. Scores of the results were correlated with education and economic status (measured by house quality and mother's education). The Atole recipients, particular early in age scored better in the tests. The best result was for the poor socio-economic group. The Atole group had also increased educational achievement (37). The study is a strong evidence for the relationship of undernutrition, poverty and school performance.

A matched case-control study was conducted in Jamaica. Nineteen children with Trichuris (aged 27 months to 6 years old) were matched with uninfected control children. Infected children were found stunted, -2.2 ± 1.1 Z-score versus -0.2 ± 1.1 Z-scores of the control group ($p<0.001$). Infected children who were living with their father were significantly lower in number than the control (4 versus 10). The malnourished children scored less in every subscale of Griffiths. On multiple regression analysis the presence of father was the factor which determined intellectual development of the child (57).

Another study was conducted in Sao Paulo City, Brazil, on 252 children aged 6 months-60 months old using the risk approach analysis and a combined nutritional classification of Gomez's and Waterlow's methods. The risks of moderate undernutrition were found 2.85 ($P < 0.05$), and 2.71 ($P < 0.05$) for Ascaris lumbricoides and Trichuris trichiura infections respectively. Ascaris was also found associated with poverty (RR 1.47, 95%CI= 1.03-2.0.8, $P < 0.05$), (58).

In Mandevilk town (Jamaica), school children aged 9-12 years old, who were infected with Trichuris trichiura were found absent from school twice as compared to noninfected (59). Rural primary school children, (also in Jamaica), who had infection of whipworm and ascaris, and mild PEM were found achieving lower scores in spelling, reading and arithmetics (60).

In Jima, Ethiopia, intellectual ability assessed by Ravens test were found significantly lower in stunted children than nonstunted ones (61).

From the literature review it became clear that the magnitude of PEM, and the relationships of PEM with IPI need to be studied in Ethiopian primary school children. The magnitude of stunting, and stunting and wasting was studied by Bekele A. et. al. (20) before 16 years for a subsample of children aged 6-10 years. This subsample represented a very small fraction (12.9%) of the total sample of 132 study subjects, aged 6-18 years. No study was conducted regarding the effect of IPI on nutrition in Ethiopian primary school children.

3. Study Objective

General:

To assess the magnitude and association of nutritional status, IP infection and school performance of school children.

Specific:

1. To determine nutritional status of primary school children
2. To determine the prevalence of IP infections in primary school children
3. To assess the effects of IP infections on nutrition status.
4. To examine the effect of malnutrition on school average score
5. To examine the effect of IP infections on school performance
6. To identify socio-demographic factors which are associated with school average score and MN.

4. Methodology

4.1. Study design : - This was a cross-sectional survey which was conducted in April 1992 E. C./2000 G. C., to assess the magnitude of PEM, and IPI among Teda primary school children. The study has both descriptive and analytic components. The descriptive part of the study had included the socio-demographic factors of the children and their parents. The analytical part of the survey had made internal comparisons to identify some socio-demographic risk factors such as influence of religions, urban or rural residences on PEM. Influences of PEM, and IPI on school performance were analyzed.

4.2. Study area and population.

Study area: The study was conducted on primary schools in Teda town, North Gonder, Amhara Region, Northwestern Ethiopia.

Teda town is a small special kebele (a small administrative unit), located on the sides of the main all weather road between Gonder town and Addis Ababa. It is a 40-minute car-drive distance from Gonder town and is one of the four towns of the newly formed Gondar Zuria Woreda. This woreda is one of the 16 woreds of North Gonder administrative zone. According to the 1994 national census, the town (Teda) had a total population of 2853, of which 869 (31%) were children between the age of 5 years - 14 years. Out of the total 719 housing units of the town, 666 (93%) were made of wood and mud, 413 (57%) were using communal tap water, and 236 (33%) were using river water, 582 housing units (81%) had no

toilet, 83 (12%) had private latrine and 49(7%) had shared toilet (62).

The zonal capital, Gondar town and Teda town have similar altitudes, climates and cultures. Gondar is at 2200 meters above sea level. The climate of Teda is woina dega (moderate climatic conditions) with mean annual temperature between 13 - 20 degree centigrade and mean annual rainfall between 1200 - 1500 cm (according to North Gondar Zonal Planning and Economic Development Department, 1998). Also according to the information obtained from Teda administration and school directors, six villages or peasant associations are surrounding Teda town, though they were not under Teda administration. The villages are well known for cattle raising and growing of food crops. Children from these villages were attending their primary education in Teda town since schools were not available in their villages. The total population of the villages was around 16 thousands (62).

There were two primary schools in the town namely, Teda Elementary School, and Teda Elementary and Junior Secondary School. According to the respective school enrolment list of 1992 E. C.(1999/2000 G.C.), Teda Elementary and Junior Secondary School had a total of 844 pupils from grades 1-8, and Teda Elementary School had also about 809 pupils from grades 1-4.

The study population was children, aged 6 years - 14 years, of the primary schools of Teda who were in grades 1- 4, and had taken the first semester examinations of Teda Elementary School and Teda Elementary and Junior Secondary School. According to the information

given by the respective school directors, the students, aged 6 years - 14 years, who were learning in the elementary schools of Teda were from Teda town and the six surrounding villages. The majority of these students were from the six villages.

Inclusion criteria : Eligibles for the study were students in grades 1- 4, and who were learning in and had taken the first semester examinations of Teda primary schools. Results of the school examinations of the first semester were needed for assessing the effect of IPI, and PEM on school performance (as it was measured by average score). School average score could measure school performance, even though it is a crude, complicated and liable to bias measurement due to the involvement of different kinds of subjects (like Amharic and English languages, etc.), and many teachers in it. Validation of Ravens with school marks by correlation scores was done. And the Pearson Product Moment correlation between final school marks and Ravens test scores was found to be 0.36 ($p<0.001$) in that study (61).

The age group of 6 years-14 years was chosen because the focus of this study was on school children. Since no other better source of accurate age record (like vital registration) was available in the study area, the age (in years) of each student was taken from each school's master list or roster, in which were listed also examination results, and other informations of each student. Months of the school recorded age might be rounded down or upward to the nearest complete year. In such case, the over and under estimationes of age could be balanced (compensated) or canceled out. Age underestimation leads to underestimation of stunting and underweight. And overestimation of age gives overestimation of stunting and underweight.

Out of 1008 eligible students from both schools, a sample of 630(64%) students was selected by using random or probability sampling method (as described in the section of sampling method below). Out of 736 eligible students of Teda Elementary School, 422 (57%), and out of 272 eligible students of Teda Elementary and Junior Secondary, 208 (76%) were selected and included in the sample.

4.3. Sample size and sampling method.

sample size = n = 600 children, by using the formula

$$n = \frac{(Z\alpha_{/2})^2 \, pq}{d^2} = 600$$

With the 5% contingency addition, the sample size = $n_1 = 630$

Where :

n_1 = n + (5% of n) = 600 + (600 x 5/100) = 630 ; the 5% of addition is a contingency for nonresponse compensation.

$Z\alpha_{/2}$ = 1.96, which is Z value that corresponds to the 95% confidence interval.

p = proportion of stunted children assumed to be 50%. Since no previous study had provided the prevalence rate of stunting in Ethiopian primary school children, 50% prevalence rate of stunting was taken, in order to get the required sample size which ensured valid estimate of prevalence, and statistically significant analyses of the data,

q = nonstunted children assume also to be 50%.

$d^2=(0.04)^2 = 0.0016$ = margin of error, tolerated discrepancy between values of the sample and the study population.

Sampling method:- A multistage sampling was used to select the sample. To give more detail, it was a two-stage sampling. The first stage was stratified cluster sampling with proportional allocation to size, and the second stage was simple random sampling.

From each school's list or roster the total number of sections in each grade and the total number of students in each section from grades 1-4 were obtained. After that stratification with proportional to size allocation by grade was done. The unit of sampling in the first stage was sections of a grade, and in the second stage the individual pupils were the unit of sampling.

Then to be included in the study or sample, until the required size of a grade level was obtained, one or more section(s) was/were selected by simple random sampling (lottery) method. When the selected section(s) of the particular grade level could not give the exact required (proportional) size for that grade level, by the same lottery method, one section of that particular grade level was selected as a reserve to complete the required size. Subjects from the reserve section were selected by simple random sampling method until the required number of the grade level was obtained. The final sample consisted of clusters of many complete and incomplete grade-sections from grades 1-4 of both schools. More than 50% of the students from each school were included in the sample (see Appendix I. Table 1A.).

4.4. Materials and instruments

A. Questionnaire for individual interview.

A standardized, closed-ended and coded questionnaire with a few open-ended questions was prepared first in Amharic, which is the language of the study population. Then the questionnaire was translated into English, and it was translated back into Amharic to check and correct any inconsistencies or distortions of words or concepts. The first part of the questionnaire had included socio-demographic variables of the pupil and his/her family. These variables were pupil's name, sex, wearing or using of shoes, ethnicity, parents education, and occupation, number of rooms and persons in the house, availability of latrine, sources of water, and others (see Appendix II. Part two).

The second part of the questionnaire (Appendix II. Part three) had included: Firstly medical history or the presence or absence of selected symptoms like vomiting, pain, itching, insomnia, poor appetite, cough, easy tiredness, hearing or vision difficulty. Secondly nutritionally important diseases like the presence or absence of recent diarrhea, past history of whooping cough/measles, pulmonary tuberculosis, malaria, and IPI. And thirdly selected determinants of education such as the presence or absence of hunger, personal or family illness, workload, lack of family support or educational material, time shortage, and others. All the variables of the second part of the questionnaire were collected by trained health assistants.

B. Checklist or recording format.

This format was used for data gathering from each school list regarding each pupil's name, sex, age, the first semester school absenteeism, and section average score, and others (Appendix II. Part one). Age was used as exposure for PEM, and IPI, and to calculate nutritional indices or underweight, and stunting. The last semester school absenteeism, average score were used as outcome variables for PEM, and IPI.

C. Anthropometric measurement:

A digital portable weighing scale labeled as "Qualitat Skontrolle SI 605, Soehnle, Germany" was used for weight measurement. This scale could measure upto 130kg to the nearest 0.5kg. A portable plastic instrument labeled as "Leicester Height Measurement, Case Strap, CMS Weighing Equipment LMD, UK" was used for height measurement. The instrument could be disarticulated and rearticulated easily. It can measure upto 2 meters with 0.1cm precision. It has a fixed feet board and slides to fix it to a wall. Further details on anthropometric measurement were described in section 4.5.5.).

D. Physical examination.

The examination was based on palpation and inspection guided by standardized, closed-ended and coded format(checklist) for presence or absence of symptoms or diseases. The included variables were regarding the absence or presence of clean clothing, wearing or using shoes, any body abnormalities, eye discharges, goiter by using a standard goiter grading scale (38), edema, scabies, cataract, and others (Appendix II. Part four). Some of these variables were used as

exposure for IPI, PEM, and school performance (further details were described in section 4.5.5.).

E. Direct stool smear exam

A microscope which was operated with sunlight and labeled as "Olympus 866044, August Warldin INC. Japan", was used to examine direct stool smear for the presence or absence of eggs or ova of IP. The smear was prepared with 0.9% sodium chloride solution (63). More details were given below in section 4.5.5. The total items or questions (including subquestions) were 81.

4.5. Data collection procedure:

4.5.1. Getting permission for, and conducting preliminary survey.

The proposal was approved by the Ethical Committee of the Faculty of Medicine through the Department of Community Health. Permission was also obtained from the study area relevant authorities. Informations regarding the number of students in each school, grade, grade-section, and available spaces for the survey were obtained in a visit of the schools. The time schedule for data collection on each student was arranged with the school directors. The town health center was asked for some aids such as microscope, and drugs to be sold for referred pupils.

After the preliminary field survey, questionnaires, recording formats, and data collectors' instruction material were prepared. The necessary materials and drug were procured. All these

items were transported to the study area.

4.5.2. Personnel recruitment and orientation.

After one month of the first field work, three interviewers who had completed 12th grade were recruited from the study site. They were familiar with the local culture and speaker of Amharic (the local) language. One week training regarding how to interview was given to them by the principal investigator.

Other data collectors were also recruited including one nurse for physical examination, one laboratory technician, some school unit leaders and home room teachers, and two health assistants. The health assistants were also trained for three days on medical history interview and measurement of weight and height.

During the training an instruction manual was distributed to each of the trainees.
The nurse, lab. technician, and school personnel were oriented about the research and the work expected from each of them. Each school's unit leaders and home room teachers were assigned to collect the school record data.

4.5.3. Pilot survey and standardizing the questionnaire

Pretest study was carried out in a nearby elementary school. Around 46 pupils from grades 1-4 participated in the pretest. The pupils were interviewed regarding their socio-demographic characteristics by the 3 interviewers and medical interview were conducted by the health

assistants using the standardized questionnaires in Amharic language. Weight and height measurement were also taken by the health assistants.

The purposes of the pretest were to know the time needed to complete each questionnaire and measurements, and to see whether the interviewers and pupils were able to understand the questions and to check if weight and height measurements were done correctly as it was intended. A test and retest study on 16 pupils were conducted to verify reliability of the pupils' answers. About 96% of the first and the second interview answers were matched exactly. Then a feedback was given to the research workers and some questions were modified (refined) or omitted based on the reaction of the pupils on those questions. After that the final questionnaires were prepared in Amharic.

4.5. 4. Conducting data collection

Data collection was started after a week of the pretest and conducted for about one month during April 2000. The research team was given a brief instruction about the work schedule and the need of good quality work. The importance of the study and free treatment for those who have IP and scabies were explained to the school staff. The confidentiality of information given was assured. The schools' staff and administration were requested for collaboration. And adequate rooms were give by each school to do the survey at the respective school site. The name and age of the eligible pupils were obtained from their respective official school lists. Using the lists the eligible subjects were called from their section to the data collection room(s) to be studied.

The work place was arranged and the work flow was that the selected pupils were sent to the examination/interview place from their room by their attending teacher. Then the pupils went to the socio-demographic interviewers, from there they went to the health assistants for medical examination, and weight and height measurements. They continued to the nurse for physical examination. Finally stool examination was done. And the following data were collected.

1. Socio-demographic factors by interview:

First the name of the student (or interviewee) was written in the same questionnaire in which his or her data were collected. Then the socio-demographic data of each pupil were collected by the trained interviewers.

2. School record :

Using the school recording format each school's unit leader and home room teachers had collected such data.

3. Medical history by interview, weight and height measurements:

Weight and height data on each study subject were collected by the health assistants. Weighing of each pupil was done with minimal clothing and to the nearest 0.5kg. Boys were weighed wearing their trousers, while girls were weighed wearing their minimal dress. Measurement of height was carried out without wearing shoes, to the nearest 0.1cm and the findings were recorded in the prepared recording format in which was also written the student's name. Also by interviewing each pupil the health assistants had collected data regarding the absence or presence of selected diseases, symptoms, and educational determinants (obstacles).

4. Physical examination:

Applying inspection and palpation with due attention for privacy, the nurse had examined the pupils. The student's name and the findings were recorded in the recording format.

5. Stool examination:

The lab. technician with an assistant had collected data regarding the absence or presence of IP infection. After an instruction, each study subject was given a labeled plastic stool container with an applicator and paper. Each pupil was accompanied to the school toilet by the lab. assistant to ensure safe collection of specimen. Preparations and examinations of stool specimens were done by the lab. technician. On a labeled slide, a small amount of fresh stool of each pupil was mixed with sodium chloride solution, and the specimen was examined soon under light operated microscope. For each student only one slide of stool specimen was examined. The findings were recorded as present (the count) or absent of egg/larva of IP in the recording format. After completing all stool examinations treatment was given for those who had IPI on the site according to "Drug List" (64) guidelines.

4. 6. Definition of terms (operational):

School performance is defined by categorization of the sample students by their:

1. first semester school average score status as low (when the average score was below -1 standard deviation from the mean of the average score), average (when the average score was within ± 1 SD from the mean of the average score), and high (when the average score was above +1 SD of the average score's mean). The original school average score was given out of hundred to each student of the same grade level and section

for the first semester academic results.

2. or first semester school absenteeism status as high, and low or no absenteeism.

3. or past year(s) promotion status at current grade as repeater, and no repeater.

Formal education was defined as completing at least grade one. Whereas unable to read/write or nonformal education was for those fathers or mothers who were either unable to read/write or had not attended formal education but they had attended religious education from churches or mosques, or adult education.

4. 7. Data quality and instruments control:

The principal researcher was the overall coordinator and supervisor of the research activities on daily basis. During the data collection, constant monitoring and supervision were carried out. All the activities and work quality of the interviewers, the nurse and laboratory (lab.) technician were supervised.

On occasions, on the questionnaires, and formats filled in by interviewers, the principal researcher had carried out counter-checks and any deviations were corrected immediately. From each school, 20 completed records were also checked against the original sources or the School Master List (roster) for reliability of the data.

The correct use and fill out of questionnaires and recording formats were checked by the supervisor during the night time. Any mistakes or inconsistency or omissions were corrected

as soon as possible. Any missed data were obtained within 24-48 hours. The socio-demographic and medical history questionnaires were tested for reliability by the pretest (pilot) study (as it was described above in the Personnel Recruitment and Training part). The necessary readjustment was made based on the pretest and retest results. The physical examination data were also tested for reliability against the supervisor's results on some students. No serious problems were encountered. The weight scale was checked at the beginning of each working day and midday against a standard of 5kg object which was kept for such purpose. Stool re-examination of some students had served as a challenge for the lab. technician to be more serious on the examination. Because it was made known that repeated errors were intolerated. And the study results were compared with other studies to validate the data of this study.

4.8. Data processing and analysis

4. 8.1. Entry, cleaning, and recoding

The majority of the variables were precoded before the survey. The coded data were entered into a computer which had included EPI INFO VERSION 6. They were cleaned by running frequencies and printouts and some mistakes or inconsistencies were corrected.

Operationalization/transformation of many variables were done including the following ones.

1. Anthropometric indices were calculated using EPINUT (subprogram of EPI INFO). These indices were expressed using Z-score (65), in relation to the reference median of the National Center for Health Statistics (NCHS). Underweight, stunting, and wasting were expressed by

weight for age Z-score (WAZ), height for age Z-score (HAZ), weight for height Z-score (WHZ) respectively using < -2 standard deviation (< -2SD) of Z-score as a cut-off. This cut-off was also used for both wasted and stunted which was the combination of HAZ and WAZ. Nutritional status was used as exposure variable for school performance, and as outcome variable for the socio-demographic variables (exposures) and IP infection (exposure).

2. Each symptom of disease, or each disease or physical examination finding was coded individually as yes or no. All the symptoms were also grouped together, and recoded as ' yes' when at least one symptom was present and 'no' when at least one symptom was not present. The same was done for all diseases or all physical examination findings. Symptoms like vomiting, and anorexia, and diseases like diarrheal disease, and measles were used as exposure for nutritional status or school performance. There was great potential for recall bias especially in the younger school children.

3.. Educational obstacle(or determinant) variables were also dichotomized individually as yes or no, and grouped as yes or no by the presence of at least one obstacle. They were served as exposure for school average score and absenteeism.

4. Average score was categorized into 3 to be used as outcome variable for IPI, PEM and socio-demographic factors. Also using the median as cut-off, days of school absenteeism was classified as "low or no absenteeism" when it was equal to or less than the median or zero, and "high" when it was above the median school absenteeism days.

5. Some of the socio-demographic factors were used to create new variables. For eg. socio-economic status (SES) was created by giving a relative scores to some items. (A comparative value to each item in relation to the other items). Then these scores were dichotomized as high

or low SES using the median score as a cut-off. SES as the rest of the socio-demographic factors was used as exposure for school performance, and PEM. The items and the corresponding relative scores were given in Appendix III. Table 1B.

6. Stool examination results were dichotomized as present or absent of eggs/larvae of a particular IPI (because it was difficult to use in a meaningful way the counts of the direct stool smear results which were reported as, "no", "few ", "3", "4", "too many", etc. eggs/larvas/ cysts of IP). In addition, all IPIs were recoded as one group with yes/no by the presence of at least one IPI.

4.8.2. Data analysis.

The data analyses were also carried out using EPI Info version 6., and the Statistical Package for Social Science Version 10.(SPSS) Softwares.

1. The anthropometric indices were used to indicate the nutrition status of the study population in relation to the reference median Z- score. Those who were below -2 standard deviation (SD) from the median Z-scores were undernourished, and described by percentage (undernourished x 100, over the total sample students).

2. The prevalence rate of the overall or individual IPI was expressed as percentage of the positive pupils over the total sample, and presented in frequency table.

3. The school performances were expressed as percentages of low, average or medium, and high average score, high and low or no absenteeism, and repeat/not repeat at current grade.

4. The association of IPI (using as exposure infected or uninfected) and nutrition status (as outcome variable normal or stunted or underweight) was analysed by a 2 x 2 table, odds ratio

(OR), and 95% confidence interval (95% CI).

5. The socio-demographic variables (as exposures) were analysed in relation to

5.1. nutrition status as outcomes using a 2 x 2 table, crude OR (95% CI).

5.2. School average score (as outcome) by using a 2x3 table, and X^2 (p value), absenteeism by using a 2x2 table, OR (95% CI).

6. Adjustments or logistic regression analyses were carried out to rule out (control) confounders of the socio-demographic variables (exposures) for the outcome variable of nutritional status (like underweight and not underweight), and school performance(like high or low absenteeism). All the analytical results were presented in tables.

5. Ethical issues consideration

Ethical approval was obtained from the Ethical Committee of the Faculty of Medicine through the Department of Community Health. Informed verbal consent or permission was also obtained from North Gonder Zonal Education, and Health Departments. Each of these zonal departments was passed the message of permission to their respective lower woreda and Teda town administrations including the schools and health center.

The freedom of the pupils to participate or not participate in the study was explained to the study subjects. The importance of the study and the free treatment for those who have IPI, scabies and other illness was also explained.

The confidentiality of the data was assured (i.e. access to data was limited only for the research team).The study had no harm to the study subjects.

At the end of the study, according to the "Drug List" (64)guidelines, treatment was given to those pupils who had intestinal parasites, scabies, and for one case of vitamin A deficiency by the study team at their respective schools. Education on nutrition, personal hygiene and environmental sanitation was also given to the pupils and school staff by the researchers. A few parents of very emaciated children were advised to take the necessary care for their children. They were counselled to keep good hygiene, prevent IPI, PEM, and help the children in all possible ways.

6. Results.

A total of 641 students, from grades 1 to 4, were enrolled in the study. Considering the 630 sample students, the response rate was 100% or complete . Eleven (additional) students were included in the sample due to the addition of one student from each of grade three, and four by rounding the fraction (which was resulted from the calculation for proportional allocation) to the next counting or whole number. And after the selection by simple random sampling and inclusion of 32 and 42 students from the reserve sections of grade one and two respectively, stool examinations were done on the remaining (unselected) students for purpose of treatment in case of the presence of IPI. But by mistake complete data of 6 and 3 students were collected from the reserve section of grade one and two respectively, and they were included in the study sample (Appendix I Table 1A.).

Socio-demographic characteristics of the study subjects.

The sample consisted of 433 (67.6%) students from Teda Elementary and 208 (32.4%) students from Teda Elementary and Junior Secondary Schools. Of the 641 study sample, 278 (43.3%) were urban and 363 (56.6%) were rural residents. Female and male students were 399 (62.2%) and 242 (37.0%), respectively. The majority, 607 (94.7%) of the study subjects were Orthodox Christians and almost all, i. e. 99.7% of the study subjects were from the Amhara ethnic group (Table 1.).

Concerning educational status of parents, out of the total 603 fathers, 159 (26.2%) were unable to read/write, and 244 (40.5%) were able to read/write (non formal education). About 22% of them had completed grades from 1 through 12. Only 8% of the fathers were above 12 grade level. In contrast to their daughter students, educational status of mothers (N=629) showed that the proportion of the mothers who could not read/write was more than double (60.1%) of that of the fathers (26%), Table 2. While 116 (18.4%) were able to read/write, and only about 16% of them had completed 12 grade. About half, 331 (51.6%) of the fathers of the study subjects were farmers by occupation. Around 11% of them were government employees. Many others were also involved in many different occupations, including handcrafts, and house construction, growing of seedlings for afforestation, and sheep/cow herding etc.

Socio-economic conditions of the study subjects and their parents.

Out of the 641 sample, only 29.2% had radio and 2.8% had TV (Table 3).

Similarly, 539 (84.1%) had their own house, while the rest (15.9%) had rented their living house from kebele or private persons. Regarding housing conditions, 399 (62.2%), 629 (98.1%), and 367 (57.3%) of subjects were living in houses with corrugated iron sheets, earthened floors, and single rooms respectively. While the rest, 242 (37.8%), 12 (1.9%), and 274 (42.9%) were living in thatched, cemented, and two or more room houses respectively. Around 84% of the study subjects were using safe drinking water, which was from tap/protected spring or well. The rest were getting their drinking water from unsafe sources, including rivers, or unprotected or uncleaned springs and wells. Protected spring or well was used to indicate spring or well which was covered with cement or other uncontaminated

(hygienic) material, and regularly or yearly cleaned (as reported by respondents). The categorization of drinking water sources as "safe" and "unsafe" were not based on bacteriological criteria, they were labeled as such simply by common sense, just as one can think of them by their apparent status.

Only 231 (36.0%) of the study subjects had electricity supply, and 287 (44.8%) of them had kitchen. Availability of latrine was found to be at 127 (19.8%).

Characteristics of school performance of the students.

The 641 students were categorized by their school average scores of the first semester (Table 4). Only 94 (14.7%) of the students had achieved low average scores (or 13-43%), while 440 (68.6%) of the students were between the low and high average scores. The high average score was 78-96%, in which was included 107 (16.7%) of the students. Around 41% of the students were absent more than the median 4 days from school during the first or last semester. And 12% of the students were repeating the last year grade.

Table 1. Socio-demographic characteristics of Teda primary school children, April 1992 E.C./2000 G. C.

Socio-demographic factor N=641	Number of students	Percent
Residence:		
Urban	278	43.4
Rural	363	56.6
Sex:		
Male	242	37.8
Female	399	62.2
Grade:		
One	246	38.4
Two	175	27.3
Three	113	17.6
Four	107	16.7
Name of school:		
Teda Elementary School	433	67.6
Teda Elementary and Junior Secondary School	208	32.4

Table 2. Socio-demographic characteristics of parents of Teda primary school children, April 2000.

Socio-demographic factor N=641	Number	Percent
Religion:		
Orthodox Christian	607	94.7
Muslim	31	4.8
Others	3	0.5
Ethnicity:		
Amara	639	99.7
Others	2	0.3
Father education (N=603):		
Unable to read/write	159	26.2
Able to read/write (nonformal education)	244	40.3
1-6 grade	73	12.1
7-12 grade	59	9.8
Above 12 grade	48	8.0
Others	20	3.3
Mother education (N=629):		
Unable to read/write	378	60.1
Able to read/write (nonformal education)	116	18.4
1-6 grade	54	8.6
7-12 grade	47	7.5
Above 12 grade	23	3.7
Others	11	1.7
Father occupation:		
Farm	331	51.6
Government employee	72	11.2
Trade	51	8.0
Daily laborer	30	4.7
Jobless	13	2
Private employee	9	1.4
Others	135	21.0

Table 3. Socio-economic condition of Teda primary school children and their parents, April 2000.

Socio-economic factor N=641	Number	Percent
Availability of radio:		
Yes	187	29.2
No	45	70.8
Availability of TV:		
Yes	18	2.8
No	623	97.2
House ownership:		
Owned	539	84.1
Rented from Kebele	87	13.6
Rented from private	15	2.3
House roof condition:		
Corrugated iron sheet	399	62.2
Thatched	242	37.8
House floor condition:		
Earthened floor	629	98.1
Cement	12	1.9
Number of rooms per house:		
One	367	57.3
Two	167	26.1
Three	85	13.3
Four or more	22	3.5
Availability of electricity:		
Yes	231	36.0
No	410	64.0
Availability of kitchen:		
Yes	287	44.8
No	354	55.2
Water supply:		
Private tap	30	4.6
Public tap	205	32.0
Buying from private tap	105	16.4
Cleaned spring/well	198	30.9
Uncleaned spring/well/river	103	16.1
Latrine availability:		
Yes	127	19.8
No	514	80.2
Latrine ownership (N-127):		
Private	116	91.3
Shared with neighbor	11	8.7

Table 4. Characteristics of school performance of Teda Primary School Children, April 2000.

School performance variable N=641	Number of students	percent
Average score :		
top or high (78% - 96)%	107	16.7
middle or average (44% - 77%)	440	68.6
low or poor score (13% - 43%)	94	14.7
Absenteeism (days):		
high (≥5)	276	43.1
low (≤4)	365	56.9
Repeating status at current grade:		
repeater	75	11.7
Nonrepeater	566	88.3

NB the mean and SD of the average score were 60% and 17% respectively.

Nutritional status of the study subjects.

Nutritional status of the study subjects revealed that 383 (59.8%), and 267 (41.7%) had underweight (below -2SD of WAZ), and stunting (< -2SD of HAZ) respectively. For wasting index only students below 11 years old were included. Of the total 320 eligible students, 132 (41.3%) were wasted (< -2SD of WHZ), and among them wasting and stunting together was found in 15.3% (Table 5).

Intestinal parasitic infection (IPI) status of the study subjects.

The overall IPI rate (the presence of at least one IPI) was 77.7%. Around 51% and 24% of the study subjects had one and two IPIs respectively. Of the individual parasites, the most prevalent was ascaris (67.2%), followed by ameba which was 14.8% (Table 6). No single infection of hookworm or whipworm was detected in the study subject.

Effect of IPI and PEM on school average score (performance) of the study subjects.

The classification of average score was the same as in Table 4.

A significant association was found between underweight and low average score, $X^2 = 39.45$ ($p < 0.0001$). Stunting was also significantly associated with low average score, $X^2 = 19.79$, ($p < 0.0001$), Table 7. But wastimng and IPI were not associated with average score of the students, $X^2 = 1.12$ ($p > 0.5340$). and $X^2 = 1.87$ ($p > 0.3930$) respectively.

Table 5. Protein energy malnutrition at Teda Primary School children, April 2000.

Type of malnutrition N=641	Number of undernourished	percent
Underweight, (WAZ<-2SD)	383	59.8
Stunting, (HAZ<-2SD)	267	41.7
Wasting, N=320, (WHZ<-2SD)	132	41.3
Wasting & and stunting, N=320, (WHZ<-2SD & HAZ<-2SD)	49	15.3

Table 6. Intestinal parasitic infection of Teda primary school children, April 2000.

Type of parasite N=641	Number of infected students	Percent
Ascaris lumbricoides	431	67.2
Entameba histolytica	95	14.8
Giardia lamblia	52	8.1
Pinworm	41	6.4
Taenia	35	5.5
Strongyloides	22	3.4
S. mansoni	15	2.3
Only one parasite	325	50.7
Two parasites	153	23.9
Three parasites	20	3.1
At least one parasite	498	77.7

Table 7. Distribution of IPI and PEM by school average score (performance) of Teda primary school children, April 2000.

Exposure variable N=641	Number of students(%), per average score category 13-43%	44-77%	78-96%	X^2 (p value)
Underweight:				
yes	73(19)	272(71)	38(10)	39.45(0.0000)
no	21(8)	168(65)	69(27)	
Stunting:				
yes	45(17)	198(74)	24(9)	19.79(0.0000)
no	49(13)	242(65)	83(22)	
Wasting (N-320):				
yes	35(27)	90(68)	7(5)	1.21(0.5342)
no	46(25)	126(67)	16(8)	
IPI:				
yes	78(16)	339(68)	81(16)	1.87(0.3932)
no	16(11)	101(71)	26(18)	

Socio-demographic determinant of PEM.

A. Underweight.

Among the socio-demographic factors only age groups, and residence were significantly associated with underweight (Table 8). A higher percentage of the younger age group was underweight than the older age group, crude OR (and 95% CI) equal to 1.86 (1.32, 2.64), and adjusted OR=1.45 (95% CI=1.01, 2.06). More urban than rural students were also underweight, crude OR= 2.25 (95% CI = 1.59, 3.18), and adjusted OR=2.60 (95% CI=1.64, 4.13). On the other hand, sex, family size, SES, latrine availability, religion, and parents education did not show any significant association with underweight. The significant association between water source/s (confounder) and underweight by the crude odds ratio and its 95% CI had been disappeared by the adjustment analysis.

B. Wasting

None of the factors such as sex, age groups, residence, family size, religion, parents education, SES, water sources, latrine availability, or selected diseases and symptoms were found to be significantly associated with wasting (Table 9). The median age for the groups was 10 years and the median family size was 7.

Table 8. Effects of socio-demographic and selected health factors on nutritional status of Teda primary school children, April 2000.

Exposure variable N=641	Nutritional status of students(%): underweight	nounderweight	crude OR(95%CI)	adjusted OR(95%CI)
Sex:				
male	150(62)	92(38)	1.16(0.83, 1.64)	1.08(0.75, 1.55)
female	233(58)	166(42)		1.00
Age groups:				
6-9 years	191(69)	90(32)	1.86(1.32, 2.64)	1.45(1.01, 2.06)
10-14 years	192(53)	168(47)		1.00
Birth order:				
4-13rd	161(60)	106(40)	1.03(0.74, 1.45)	1.26(0.65, 1.66)
1-3rd	222(59)	151(41)		1.00
Residence:				
urban	196(70)	82(30)	2.25(1.59, 3.18)	2.60(1.64, 4.13)
rural	187(51)	176(49)		1.00
Water source(s):				
unsafe	47(46)	56(54)	0.58(0.32, 0.79)	0.81(0.49, 1.34)
safe	336(62)	202(38)		1.00
Latrine:				
unavailable	306(59)	208(41)	0.92(0.60, 1.40)	1.17(0.72, 1.91)
available	77(61)	50(39)		1.00
Socio-economic status:				
low (≤4 scores)	242(59)	168(41)	0.92(0.65, 1.29)	1.29(0.86, 1.94)
high (≥ 5 scores)	141(61)	90(39)		1.00
Family size:				
7-15 members	200(61)	127(39)	1.13(0.81, 1.57)	1.33(0.93, 1.89)
1-6 members	183(58)	131(42)		1.00
Religion:				
Orthodox Christian	358(49)	249(51)	0.52(0.22, 1.19)	0.89(0.39, 2.03)
others	25(73)	9(27)		1.00
Mother education (N=629): unable to read/write or nonformal education	295(58)	210(42)	0.69(0.45, 1.07)	0.74(0.43, 1.28)
formal education	83(67)	41(33)		1.00
Father education (N=603): unable to read/write or nonformal education	256(60)	167(40)	0.95(0.65, 1.39)	0.51(0.95, 2.40)
formal education	111(62)	69(38)		1.00
Selected diseases and symptoms:				
present	349(60)	235(40)	1.0 0(0.55, 1.82)	1.12(0.62, 2.03)
absent	34(66)	23(36)		1.00

NB 1.00=referent group.

Table 9. Effect of health and socio-demographic factors on nutritional status of Teda primary school children, April 2000.

Exposure variable (N=320)	Nutritional status of students Wasting(%)	No wasting(%)	OR(95%CI)
Sex:			
male	64(40)	96(60)	0.90 (0.56, 1.45)
female	68(43)	92(57)	
Age groups:			
6-9 years	115(42)	159(58)	1.23 (0.62, 2.49)
10-14 years	17(37)	29(63)	
Birth order:			
4-13rd	64(43)	84(57)	1.15(0.72, 1.86)
1-3rd	68(40)	104(60)	
Residence:			
urban	69(40)	105(60)	0.87 (0.54, 1.39)
rural	63(43)	83 (57)	
Water source/s:			
unsafe	16(40)	24(60)	0.94 (0.45, 1.96)
safe	115(41)	164(59)	
Latrine:			
unavailable	98(40)	147(60)	0.80 (0.46, 1.41)
available	34(45)	41(55)	
Socio-economic status:			
low (≤ 4 scores)	76(40)	115(60)	0.86 (0.53, 1.40)
high (≥5 scores)	56(43)	73(57)	
Family size:			
7-15 members	80(46)	93(54)	1.57(0.97, 2.54)
1-6 members	52(35)	95(65)	
Religion:			
Orthodox Christian	120(40)	177(60)	0.62 (0.24, 1.58)
others	12(52)	11(48)	
Mother education (N=315):			
unable to read/write or nonformal education	98(41)	142(59)	1.00 (0.57, 1.76)
formal education	31(41)	45(59)	
Father education (N=306):			
unable to read/write or nonformal education	80(40)	122(60)	0.84 (0.50, 1.40)
formal education	46(44)	59(56)	
Selected diseases and symptoms:			
present	118(41)	169(59)	0.95 (0.43, 2.10)
absent	14(42)	19(58)	

C. Stunting

Of the Socio-economic factors, residence was significantly associated with stunting, crude OR = 2.21 (95% CI= 1.58, 3.10) and adjusted OR=2.23 (95% CI= 1.44, 3.46). And water source(s) was also significantly associated with stunting, crude OR= 0.37(95% CI= 0.22, 0.62) and adjusted OR=0.55 (95% CI= 0.32, 0.95). Higher proportion of the urban than the rural students were found to be stunted, and lower proportion of unsafe than safe water sources' users were stunted. In stunting (unlike in underweight) adjustment could not eliminate the association between water sources and stunting. One of the possible explanations could be that the rural than urban water sources were less contaminated possibly due to the sparse distribution of rural population. And probably the urban water was apparently safer but in reality was contaminated with diseases causing pathogens, and the urban water could be also contaminated by contaminated household utensils. Sex, age groups, family size, latrine availability, SES, religion, parents education, and birth order (the median birth order was 3) did not indicate any significant association with stunting for Teda schools' study sample (Table 10).

Table 10. Effect of health and socio-demographic factors on nutritional status of Teda primary school children, April 2000.

Socio-demographic variable N=641	Nutritional status of students(%) stunted	notstunted	crude OR(95% CI)	adjusted OR(95% CI)
Sex:				
male	105(43)	137(57)	1.12(0.80, 1.57)	1.01(0.71,1.44)
female	162(41)	237(59)		1.00
Age groups:				
6-9 years	123(44)	158(56)	1.17(0.84, 1.63)	0.96(0.68, 1.37)
10-14 years	144(40)	216(60)		1.00
Birth order:				
4-13rd	103(39)	164(61)	0.80(0.57, 1.12)	0.79(0.55, 1.15)
1-3rd	164(44)	209(56)		1.00
Residence:				
urban	146(53)	132(47)	2.21(1.58, 3.10)	2.23(1.44, 3.46)
rural	121(33)	242(67)		1.00
Water source(s):				
unsafe	24(23)	79(77)	0.37(0.22, 0.62)	0.55(0.32, 0.95)
safe	243(45)	295(55)		1.00
Latrine:				
unavailable	208(41)	306(59)	0.78(0.52, 1.18)	1.02(0.64, 1.62)
available	59(46)	68(54)		1.00
Socio-economic status:				
low (≤ 4 scores)	161(39)	249(61)	0.76(0.54, 1.07)	1.07(0.71, 1.59)
high (≥ scores)	106(46)	125(54)		1.00
Family:				
7-13 members	137(42)	190(58)	1.02(0.73,1.42)	1.22(0.84, 1.77)
1-4 members	130(41)	184(59)		1.00
Religion:				
Orthodox Christian	254(42)	353(58)	1.16(0.54, 2.52)	1.81(0.85, 3.87)
others	13(38)	21(62)		1.00
Mother education (N=629):				
unable to read/write or nonformal education	202(40)	303(60)	0.67(0.44, 1.01)	0.79(0.47, 1.33)
formal education	62(50)	62(50)		1.00
Father education (N=603):				
unable to read/write or non formal education	175(41)	248(59)	0.86(0.60, 1.25)	1.27(.80, 2.01)
formal education	81(45)	99(55)		1.00
Selected diseases and symptoms:				
present	244(42)	340(58)	1.06(0.59, 1.93)	1.10(0.61, 1.98)
absent	23(40)	34(60)		1.00

Effect of socio-demographic factors on students school average score (performance)

School performance was measured by the students average score (table 4).

Parents' education, and residence were found significantly associated with average score(Table 11.). Higher number or proportion of urban than rural students were in the low or lower average score, X^2 =20.42 ($p< 0.0001$).

The proportion of students who were from mothers or fathers of unable to read/write or nonformal education status was lower in low average score category than that of those students who were from mothers or fathers of formal education status, X^2, (p-value) for the mothers' and fathers' education were 6.27 ($p< 0.05$) and 6.39 ($p< 0.05$) respectively.

Effect of PEM, IPI, and socio-demographic factors on students school absenteeism.

Sex was significantly associated with absenteeism. Less number(proportion) of males were absent from school. Less number of male than female students were in low (I. e., below and including the average 4 days) category of school absenteeism, crude OR= 0.61 (95% CI = 0.43, 0.86), and adjusted OR = 0.68 (95% CI = 0.48, 0.97). IPI alone, and undernutrition did not show any significant association with absenteeism. The same was true for SES, selected diseases and symptoms, educational obstacles, and current grade repeat status(Table 12).

The distribution of intestinal parasitic infection by nutritional status.

There was no significant association between protein energy malnutrition and IPI (Table 13).

Table 11. Effect of socio-demographic factors on students' school average score of Teda primary school children, April 2000.

Exposure variable N=641	Number of students (%) per average score category, 13-43%	44-77%	78-96%	X^2(P value)
Sex:				
male	39(16)	155(64)	48(20)	4.057(0.1342)
female	55(14)	285(71)	59(15	
Residence:				
urban	55(20)	194(70)	29(10)	20.46(0.0000)
rural	39(11)	246(68)	78(21)	
Socio-economic status:				
low	52(13)	282(69)	76(18)	5.37(0.06832)
high	42(18)	158(69)	158(69)	
Mother education (N= 629):				
unable to read/write or nonformal education	70(14)	342(68)	93(18)	6.27(0.04346)
formal education	23(18)	89(72)	12(10)	
Father education (N=603):				
unable to read/write or nonformal education	63(15)	280(66)	80(19)	6.39(0.04090)
formal education	22(12)	137(76)	21(12)	
Selected diseases and symptoms:				
present	83(14)	406(70)	95(16)	2.37(0.3064)
absent	11(19)	34(60)	12(21)	
educational obstacles:				
yes	43(12)	245(71)	59(17)	3.13(0.2088)
no	51(18)	195(66)	48(16)	
Absenteeism:				
yes	47(17)	191(19)	48(14)	4.35(0.1134)
no	47(13)	249(68)	69(19)	
Current grade repeated:				
yes	11(15)	57(76)	7(9)	3.43(0.1803)
no	83(16)	383(67)	100(17)	

Table 12. IPI, PEM, and socio-demographic determinants of students' school absenteeism of Teda primary school children, April 2000.

Exposure variable N = 641	Number of students per absenteeism category(%), ≥5days	≤ 4 day	crude OR(95% CI)	adjusted OR(95% CI)
IPI:				
present	206(41)	292(59)	0.74(0.50, 1.09)	0.68(0.32, 1.14)
absent	70(49)	73(51)		1.00
Underweight:				
yes	166(43)	217(57)	1.03(0.74, 1.44)	0.70(0.30, 1.61)
no	110(43)	148(57)		1.00
Stunting:				
yes	116(4)	151(57)	1.03(0.72, 1.43)	1.34(0.58, 3.14)
no	160(43)	214(57)		1.00
Wasting (N=320):				
yes	62(47)	70(53)	1.20(0.74, 1.43)	1.95(0.56, 6.55)
no	80(43)	108(57)		1.00
Sex:				
male	86(36)	156(64)	0.61(0.43, 0.86)	0.68(0.48, 0.97)
female	190(48)	209(52)		1.00
Residence:				
urban	103(37)	175(63)	0.65(0.46, 0.90)	0.81(0.54, 1.20)
rural	173(46)	190(54)		1.00
Socio-economic status:				
low (≤ 4 scores)	190(37)	220(63)	1.46(1.03, 2.06)	1.30(0.89, 1.91)
high (≥ 5 scores)	86(46)	145(54)		1.00
Mother education (N= 629):				
unable to read/write or nonformal education	231(33)	274(67)	1.71(1.10, 2.65)	1.18(0.69, 2.02)
formal education	41(15)	83(23)		1.00
Father education (N=603):				
unable to read/write or nonformal education	205(49)	218(51)	1.98(1.34, 2.91)	1.53(0.97, 2.41)
formal education	58(32)	122(68)		1.00
Selected diseases and symptoms:				
present	253(43)	331(57)	1.13 (0.62, 2.05)	1.42(0.77, 2.61)
absent	23(40)	34(60)		1.00
Educational obstacles:				
present	154(4)	193(56)	1.12(0.81, 1.56)	0.88(0.61, 1.25)
absent	122(42)	172(58)		1.00
Current grade repeated:				
yes	30(40)	45(60)	0.87(0.51, 1.46)	0.95(0.56, 1.60)
no	246(44)	320(56)		1.00

Table 13. Distribution of intestinal parasitic infection by nutrition status of Teda primary school children, April 2000.

Nutritional status of students(outcome) N=641	IPI status(exposure) Infected(%)	Uninfected(%)	OR(95%CI)
Stunting:			
yes	212(79)	55(21)	19(0.79, 1.77)
no	286(76)	88(24)	
Underweight:			
yes	301(79)	82(21)	1.14(0.76, 1.69)
no	179(76)	61(24)	
Wasting (N=320):			
yes	108(82)	24(18)	1.26(0.69, 2.30)
no	147(78)	41(22)	
Wasting & stunting (N=320):			
yes	41(84)	8(16)	1.37(0.57, 3.38)
no	214(79)	57(21)	

7. Discussion

The overall IPI rate was 77.7%, the most frequent infection being Ascaris lumbricoides (67%) followed by Entameba histolytica (15%). Other studies in Ethiopia (27, 29, 66) have also found more or less similar results. Ali I., et. al. in Asendabo (Jima) school children had found an overall infection rate of 86%, and ascaris infection of 56% (29). Prevalence rate of ascaris infection in the general Ethiopian population was found to be 59.2% in the highlands, 7.8 % in the lowlands, and 66% in (Gonder) school children aged 6-10 years, by Tedla S. et. al. (66).

No single infection of hookworm or whipworm was detected in Teda school children. But in the nearby woreda capital, Maksegnit, Tedla S. and Jemaneh L. had found 4.2% of the males aged 10-30 years were positive for hookworm. However, they did not find any females positive for hookworm (28). Among children aged 5 years - 9 years, in areas(in North Gonder) which are at similar altitude and have similar climate as Teda town, the prevalence rate of infection of hookworm, and whipworm were found to be 3.0%, and 3.3% respectively by Zein A., et. al. (67). One possible reason for not detecting these parasites could be due to missing of the ova of such parasites by the employed method due to their low prevalence (if existed any). The other reason could be that these parasites did not really exist in the area which might have unfavorable climate or soil them.

Each IPI alone or all together as a group did not show any significant association with underweight or stunting. Other studies, in Ethiopia (68-69) and elsewhere (70), had also found

similar results. In preschool children recently Asfaw S.T. et al. had not found any association between IPI and undernutrition (68). One clinical trial with 13 and another community trial with 84 preschool children in Addis Ababa did not find any contribution of ascariasis to child undernutrition(69). And another study in South African (Bantu school children) did not find any association between IPI (schistosomiasis) and undernutrition (70).

Evidence for the adverse effect of IPI on nutrition was produced indirectly, through treatment of IPI and measuring the nutritional status of treated and untreated children. Like the Kenyan school children study (25) which had found significant associations between undernutrition and IPI. Reason given for no association (69-70), was low IPI intensity (though prevalence was high). The studies that found association were on moderate to heavy infection (25, 57). Intensity was not measured in Teda school children, and it could be the reason for no association.

Studies on undernutrition, especially on underweight of school children are scarce not only in Ethiopia, but also at the international level (71). The available studies are difficult to compare because they use different age range, methods of classification, sample sizes. And the socio-cultural and geographical backgrounds in which they were done were also different. Underweight and stunting were 59.8% and 41.7% respectively in Teda school children. The underweight figure was higher than the national figure for preschool children which was 47% in 1993 (72). But it was similar to Namibian school children aged 6-18 years (sample of 380) who were found to be 38-55.9% (below the 3rd centile of the NCHS) stunted and underweight

(73). In Indian school children aged 6-8 years, Agarwal D. K. et. al. (74), using Gomez classification, had also found 84.2% underweight (in grade I-III malnutrition).

In Latin America, among the school age children males were found more affected by stunting than females. In Peru, in 1993, 54% of males and 46% of females were found stunted. The explanation given for the difference was that school age girls spent more time at home than boys, so girls could have more access to the available food in the house (71).

In 1986-1987, in a longitudinal study of 134 school children aged 6-18 years, in Sidamo (Ethiopia), Bekele A. et. al. (20) had found 74%, and 27% of a subsample children between 6 and 10 years of age stunted in the preharvest and postharvest periods respectively. It was also found that 16% children were both stunted and wasted during the lean (preharvest) period. This nutritional variation was attributed to food availability and infection influence. Similar pattern might have existed for Teda school students if the study could have been repeated in the preharvest season. Also a similar study in Tanzania from 1982-1984, at its beginning, in a subsample of 59 children had found that 70% of the children aged 6-10 years were stunted by Tanzanian adapted Harvard reference (18). In a village of Ghana, 1990, among 886 primary school children 54.9% were found stunted (19).

In Teda students wasting was very high (41.3%) compared to the findings of Bekele A. et. al. ($n<134$) in 1986, which was 6.7% (20), and Tanner M. et. al. ($n=59$) in 1982, which was 6.8% (17), but it was similar to the study result of Ghana school children (19). The differences of

wasting prevalence could be due to sample size, geographic location, socio-economic, and time. And Tanner M. et. al. had also used different method of classification. But was really the very high prevalence (41.3%) of wasting in Teda due to the above mentioned reasons or for other reason/s? Really it is a disturbing question because there was no any notified or known famine in the study area during 2000. The subsample of 320 students was small in relation to the total sample of 641 students. It is known that the adolescents' anthropometric indices or references are inadequately developed (71). What about the school age children? The use of < -2 SD of WHZ or Waterlow classification for wasting index as adequate or appropriate measurement for the school age children is quastionable, especially in relation to our finding, which was a very high figure in a stable locality, without any known famine situation.

In Teda school children, residence was associated with stunting and underweight and water sources were also found significantly associated with stunting. Age was also found associated with underweight. Neither stunting nor underweight was associated with sex, SES, family size, latrine availability, parental education and IPI. The reasons for no association between nutrition and IPI could be that the study population was homogeneous. The other reason could be that such association in reality did not exist for that particular study population.

A greater majority of the younger age group was underweight than the older one, perhaps due to their not well developed immunity and increased vulnerability to infection (34, 42) and their less ability for food access. The town students were more affected than the rural students.

That was possibly due to more poverty in that town than in the rural. The small town was not an industrial or a business center, only a few shops and hotels were seen there. Relatively the town was heavily dependent on the rural. While the rural children could have their own land to cultivate food crops, cattle and easy or free access to the natural resources (for e.g. to firewood), and these factors could be the reasons for the relatively better rural than urban nutrition.

No single variable was found significantly associated with wasting. At school age level no other study results which were either similar or different to these results of wasting of Teda were found.

The students' school average score was significantly associated with stunting, underweight, and residence. Other studies had also found similar results (37, 61, 74- 75). But school absenteeism was associated with whipworm infection in Jamaican school children (59). This was not found in our study. IPI did not affect average score. Walker, A. R. P. et. al. had found similar result (70). Low IPI intensity was the reason given for no association. Nokes C. et. al. in one study in Jamaica had also found no association between ascaris and student's school or academic results (75). But in another study, also in Jamaica, Nokes C. et. al. had found a significant association between students' results and moderate to heavy infections of T. trichiura and A. lumricoides. Such association was found more pronounced for T. trichiura than for ascaris, because the former was more intense than the latter (76).

Average score was associated with parents' education. And it was found that unable to read/write or nonformal education was significantly lower in the urban than in the rural mothers (OR = 0.20, 95% CI =0.14, 0.30), and fathers (OR = 0.14, 95% CI = 0.08, 0.23), table not presented. Therefore low formal educational status of the rural parents (exposure) was associated with rural residence (exposure), and both (these) exposures were associated with better average score (outcome). Seemingly parents educational status was confounding with residence. But the effect seemed due to better rural nutrition since rural residence and better nutrition were associated to each other (Table 8., and 10.), and with better average score.

Average score was not associated with SES, selected educational obstacles, and diseases. The lack of association could be due to homogeneous study population on these variables or such variables might not had any association with average score, or for other unknown reason/s.

8. Strength and limitation of the study

Strength of the study: The study is one of the few studies at least in that administrative area, and it which had assessed the nutritional, and IPI status, and their effects on school performance of primary school children by using relatively standardized methodology. The cross-sectional survey was relatively cheap, quick, and appropriate to determine school children nutritional status and IPI. Using the random sampling method for this survey could evenly distribute confounders in the source population and minimize selection bias. The employed standardized questionnaire, and formats could minimize information biases, and could give good uniform or consistent results. Training of interviewers, constant field supervision, and control of weight scale might reduce interviewer or observer and equipment biases. Some of the potential confounders were also controlled by adjustment (logistic regression) method during the data analyses.

Limitation of the study

The study had limitations many of which were due to shortage of resources including manpower, financial, material, equipment, and time. The study could not determine intensity of IP infection due to financial, material, and equipment limitation. As a result the effects of intensity of IP infection on PEM and school average score were not determined. If intensity of IP infection were used the study results might been different, I. e., PEM or school average score might have been found positively associated with IPI.

The study did not use psychometric tests to supplement the association between school average

score and nutrition status for resource or manpower shortage. The SES estimation of the study population was crude due to difficulty of getting reliable standardized data source and method. Social desirability bias could have been introduced for questions related to educational obstacles. And recall bias was possible for questions related to symptoms and diseases. The study results may not reflect seasonal variation of IPI, and PEM for time limitation.

Anemia could not been determined, and it could be the other factor which could affect school performance negatively, though the probability of its existence due to hookworm seems low. But the widespread of malaria in that area could cause it (as reported by the students and encountered cases of malaria of the study subjects during the survey). Other confounders for school performance were not studied including psycho-social factors such as relationship of the child with family, teachers, students and self- esteem of the student. Such psycho-social factors may affect selectively the undernourished children as a consequence of undernutrition and in such case the study results could be attributed to both factors(PEM and its consequences). Or by psychological factors independently of PEM could affect negatively the nutritional or school performance of the children.

9. Conclusion and recommendations

It can be conclude that undernutrition and IPI were high prevalent in Teda primary school children. The town children were more undernourished than the rural students seemingly due to inadequate food intake. But this does not mean that the rural students were free of undernutrition. There were also a high number of rural students who were undernourished, possibly for the same reason of the urban students and/or due to the widespread malaria infection. Residence and water sources were found associated with undernutrition. No adverse effect of IPI on nutritional status of the students was detected. PEM and IPI did not show adverse effect on school absenteeism. The presence of one or more IPI(s) did not indicate any effect on school average score. PEM did show significant association with average score. The association of poor school average score with poor nutrition needs further study. Because causality was not possible to infer in this study, and the topic needs further study with more refined design such as case control or retrospective cohort or interventional study.

Some of the study results, like PEM prevalence, and its adverse effect on school performance, may be generalizable to that administrative areas' small towns and their surrounding villages at similar geographical location.

The only or good opportunity of child education in underdeveloped areas like Teda could be lost due to health and nutritional problems. Therefore immediate and long term interventions are necessary.

Recommendations

General

1. More comprehensive nutritional survey (including seasonal variation) is needed to determine factors which affect the school children nutritional status. And a further study with refined techniques are needed to identify determinants of IPI, and academic performance of the school children, with more emphasis on assessment of the effects of IPI, PEM, and IDA on school performance.

2. Measures to alleviate poverty are also needed including some income generating programs for the town and rural poor families.

Specific

1. The school health services should be established and strengthened to treat common health problems with simple cost-effective means. It should include education on current and local health problems emphasizing on hygiene, sanitation and nutrition .

2. Since IPI is a health problem, deworming without screening (without stool examination) twice a year (perhaps at the beginning of every semester) with broad spectrum anthelminthic drugs like mebendazole or albendazole with follow-up evaluation of infection prevalence is required.

3. Selective(targeted) school feeding or fortified food supplementation for the poor children is also recommended. This could be supported by school garden development and school cafeterias income.

4. Parent-Teacher Committee should involve the community to solve the local most

important educational problems which include undernutrition of the poor students, could invite other organizations, and relevant individuals to participate in the solution of the school children's problems.

The stakeholders or responsible for implementing or considering the recommendations are the government, MOE, MOH , ministry of agriculture, ministry of social and labor affairs, and other ministries involved in developmental activities from the top to the local level. All voluntary private or nongovernmental organizations could involve in such honorable activities. Parent-Teacher Committee should play a decisive roles to implement the above recommendations.

10. References

1. Gopaldas T. More nutrients, fewer parasites, better learning. World Health Forum, 1996; 17(4): 367-8.
2. WHO. Intestinal protozoan and helminthic infections. Report of a WHO scientific group, Tech. Rep. Series No. 666, Geneva, WHO 1981; 7-28.
3. Ministry of Health. Health and health related indicators. Addis Ababa, Ethiopia 1998, and 1999
4. Stephenson LS. Helminth parasites, a major factor in malnutrition. World Health Forum 1994; 15(2):169-171
5. Evans A. C., Stephenson L. S. Not by drug alone: The fight against parasitic helminths. World Health Forum 1995; 16: 258-261.
6. WHO. Promoting health through schools. Report of a WHO expert committee on Comprehensive school health education and promotion, Tech. Rep. Series No.870, Geneva, WHO 1997.
7. Guy Carrin, Savioli et. al. School health insurance as a vehicle for health promoting schools, WHO/HSD/HID. 99.1, Geneva, WHO 1999.
8. WHO. Diet, nutrition and the prevention of chronic diseases, Report of a (WHO) study group, Tech. Rep. Series No.797, Geneva, WHO 1990:
9. Levinger B. Cognitive development and school achievement. A review of the literature. Notes, Comments No. 186, Malnutrition, School Feeding And Educational Performance, UNESCO/UNICEF/WFP Co-operative Program,

Paris, 1989.

10. UNICEF. Food, Health And Care. New York, UNICEF 1992.

11. Martorell R. Overview of long term nutrition intervention studies in Guatemala 1968-1989. Food and Nutrition Bulletin 1992 Sept; 14(3):270-275.

12. Grantham-McGregor S. M. et al. Nutritional deficiencies and later behavioral development. Proceedings of the nutrition society, 2000; 59(1): 47-54

13. Engle P. L. et al. Infant and preschool psychological development. Food and Nutrition Bulletin 1992 Sept; 14(3):201-214.

14. Martorell R. Nature of child malnutrition and its long term implication. Food and Nutrition Bulletin 1999 Sept; 2(3):288-292.

15. Reading R. Poverty and the health of children and adolescents. Archives of diseases in childhood(The Journal of the Royal College of Paediatrics and Child Disease) 1997 May; 76(5): 463-467.

16. WHO. Tropical and intestinal parasitic diseases. World health statistics annual 1991: 15-18.

17. Rebecca J. et al. Hemoquant determination of hook worm related blood loss and its role in iron deficiency anemia in African children. Am. J. Trop. Med. Hyg. 1990; 55(4): 399-444

18. Tanner M. et al. Longitudinal study on the health status of children in rural Tanzania community: Parasitosis and nutrition. Acta Tropical (Basel) 1987; 44:137-170.

19. Inungu J. M. Prevalence of malnutrition among school children in Ejisu-

Juaben District(Abstract), Ghana, African Journal of Health sciences 995;2(4): 385-387.

20. Bekele A., Woldè-Gebriel Z., Kloos H. Food, Diet And Nutrition. In: Kloos H. and Ahmed Z: The ecology of health and diseases in Ethiopia, Westview Press, Inc, USA, 1993;85-102.

21. Zein AZ. Hematocrit levels and anemia in children in Gonder. East Africa Med. J. 1991; 68: 412-419.

22. Manson. Soil transmitted helminths. In: Manson P. E. C., Bell Bahr DR: Manson's tropical diseases, Ballier Tindal(Pubs) 1987; pp 407 - 436.

23. Palmer Dr. and Bundy D. A. P. Epidemiology of human hookworm, Ascaris lubricoides infestation in rural Gambia. East Africa Med J. 1995; 72(8): p 527.

24. Kabaterreine N. et al. Human intestinal parasites in primary school children in Kampala, Uganda. East Africa Med J. 1997; 74(5): p 311.

25. Stephenson L. S. et al. Treatment with a single dose of albendazole improves growth of Kenyan school children. Am J Trop. Med. Hyg. 1989; 41(1): pp 78-87.

26. McConnell E. and Armstrong J. C. Intestinal parasitism in fifty communities on central and plateau of Ethiopia. Ethiop. Med. J. 1976; 14 : p 159-168.

27. Lemma, A. et. al. Parasitological survey of Addis Ababa and Debrezeit school children with special reference on Bilharziasis. Ethiop. Med. J. 1968; 6: 61-71.

28. Tedla S. and Jemaneh L. The distribution of Necator americanus and Ancylostma duodenale in primary school population , Gojam and Gondar administrative regions. Ethiop. Med. J. 1984;22(2):87-92.

29. Ali I., Grima M. et al. Intestinal parasitism and related risk factors among students of Asendabo elementary and Junior secondary schools, South-Western Ethiopia. Ethiop. J. Health Develop. 1999; 13(2): 157-161.

30. Jemaneh L. et al. Prevalence of common intestinal parasites in 3 different altitude areas high, temperate and lowlands), North and South Gonder. Ethiop. Med. J. 1998; 36(1): 1-8.

31. Hendrickse R. G. Protein energy malnutrition. In: Hendrikse R. G. editors. Pediatrics in the tropics, Blackwell Scientific Publication, Oxford, 1991: 119-131.

32. Hendrickse R. G. Parasitic disease. In: Hendrikse R.G. et al., editors. Paediatrics in the tropics, Blackwell Scientific Publication, Oxford, 1991: 695-764.

33. Egdell H. G. Emotional and psychiatric disorder and mental handicap. In: Hendrikse R.G. et al., editors. Paediatrics in the tropics, Blackwell Scientific Publication, Oxford, 1991:914-946.

34. United Nations Children's Fund. Children and women in Ethiopia. A situational analysis, Addis Ababa, Ethiopia, UNICEF 1989.

35. Needlman R. D. Growth and development. In: Nelson W. E., et al., editors. Textbook Of Pediatrics, 15th ed., W.B. Saunders Company, USA, 1996:30-72.

36. Ebrahim G. J. Social and community pediatrics in developing countries: Caring for the rural and urban poor. MacMillan Publisher Lmd, Hong Kong, 1985.

37. Brown J. Larra and Pollitt Ernesto. Malnutrition, poverty and intellectual development, Scientific American Feb.1996;224(2):38-43.

38. Jelliffe D. B., Jelliffe E. F. Patrice: Community coutrition with special reference to less technically developed countries, Oxford University Press, Britain, 1989.

39. Walker A, Walker C. Poverty. In: Kupper A., Kupper J., editors. The Social

Science Encyclopedia, 12nd ed., Routledge, London, 1996, 655-657.

40. Schaftan C. Technical, ethical and ideological responsibility in nutrition, World Review Of Nutrition and Dietics 1987; 53:1-27.

41. Galbraith J K. The nature of mass poverty, Penguin books, Great Britain, 1980.

42. Mata L. Nutrition And Infection. In: Warren K. S./A. A.F. Mahmoud, editors. Tropical And Geographical Medicine, 2nd ed., MacGraw-Hill, Inc., USA, 1990, 174-178.

43. Dhillon H. S., Philip L. Health promotion and community action for health in developing countries, Geneva, WHO, 1994.

44. Winick Myron. Malnutrition And Brain Development, Oxford University Press, New York, 1976.

45. Cooper G. et al. Protein and amino acid. In: Gluckman P.D., Heyman M. A. Pediatrics And Perinatology. The Scientific Basis, 2nd ed., Oxford University Press, Great Britain, 1996: 127-136.

46. Eastwood M. Principle of human Nutrition, Chapman and Hall London, UK, 1997.

47. Milich R. et al. Sugar and attention deficit disorder. In: Essman W.B, editor. Nutrients And Brain Function, Karger, Switzerland, 1987: 138-150.

48. Wharton B.A. Iron nutrition in childhood. Acta Pediatr Scand, 1989; suppl 361(5):5-11.

49. Kloos H And Tesfayohans T. Intestinal Parasitism. In : Kloos H and Ahmed Z editors. The ecology of health and disease in Ethiopia, Westview Press, USA, 1993: 223-235.

50. Whitefield P. J. Parasite helminths. In: Cox FEG ed. Modern Parasitology. A Textbook Of Parasitology, 2nd ed., Blackwell Scientific Publication, Oxford,

1993: 24-52.

51. WHO. Prevention and control of intestinal parasitic infection. Report of A WHO expert committee, Geneva, WHO 1987.

52. Teka G. The status of environmental health programs, their multisectorality and co-ordination mechanism in Ethiopia, Research project, Department of Community Health, Faculty of Medicine, Addis Ababa University 1993.

53. Crompton D. W. and Savioli L. International parasite infection and urbanization. Bulletin WHO 1993;71(1):1-7.

54. Cooper E.S. et al. Intestinal nematodes infection in children; the pathophysiological price paid. Parasitology 1992; 104: S91-S103

55. Dundy D. A. P. and Golden M. H. N. The impact of host nutrition on gastrointestinal helminths populations. Parasitology 1987; 95: 623-635.

56. Spreen O., et al. Human Developmental Neuropsychology, Oxford University Press, Inc., USA, 1984.

57. Callender J. et al. Dcvelopmental levels and nutritional status of children with trichuris dysentery syndrome, Trans Roy Soc Trop Med Hyg 1993:87:528-529.

58. Sawaya A.L. et al. The risk approach in preschool children suffering malnutrition and intestinal parasite infection in city of Sao Paulo, Brazil, J. Trop. Pediatrics, August, 1990:36:184-188.

59. Nokes C., Bundy D. A. P. Compliance and absenteeism in school children; Implication for helminth control, Trans Roy Soc Trop Med Hyg,, 1993:87: 148-152.

60. Hutchinson, S. E. et. al. Nutrition, geohelminth infection and school achievement in rural Jamaican primary school children(Abstract), Eur. J. Clin Nutrition, Nov. 1997:51(11):729-35.

61. Aboud Frances et al. Intellectual, social and nutrition status of children in an

Ethiopian Orphanage, Soc Sci Med, 1991:33(11):1275-1280.

62. Central Statistics Authority. The 1994 Population And Housing Census For Amhara Region, Vol. 1 part 1, 4, and 5, Central Statistics Authority, Ethiopia.

63. WHO. Part II. Parasitology. In. Manual of basic techniques for a health laboratory, Geneva, WHO 1980: 11-162.

64. Lulseged S.(editor). List of selected drugs for pediatrics use in Ethiopia., 3rd edition, Published by Family Health Department of the Ministry Of Health, and Swedish International Development Agency, Addis Ababa, Ethiopia, 1996.

65. WHO. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee, Geneva, WHO 1995.

66. Tedla S. and Ayele T. Ascariasis distribution in Ethiopia. Ethiop. Med. J. 1986;24(2):79-86.

67. Zein A., et. al. The prevalence of intestinal parasites among farming cooperatives in Gonder Region, northwestern Ethiopia. Ethiop. Med. J. 1985; 23: 159-167.

68. Asfaw, S. T. Goitom, L. Malnutrition and enteric parasitosis among under five children in Aynalem village, Tigray. Ethiop. J. Health Dev. 2000;14(167-75).

69. Lennart F. et. al. Ascariasis and malnutrition. A study in urban Ethiopian children. Am. J. Clin. Nutr 1979; 32:1545-1553.

70. Walker A. R. P. et. al. Studies on schistosomiasis in South African Bantu school children. Am. J. Trop. Med. Hyg. 1970;19:792-814.

71. Nutrition throughout the life cycles, 4th Report on the world nutritional situation. United Nations administrative committee on coordination, Subcommittee on nutrition (ACC/SCN) in collaboration with International food policy research institution, 2000: 1-21.

72. Central Statistical Authority, Addis Ababa, Ethiopia 1992.

73. Jooste P.L. et. al. Nutritional status of primary school children with endemic

goiter in Caprivi, Namibia(abstract). Cent. Afri. J. Med. 1994;40(3): 60-66.

74. Agarwal D. R. et. al. Influence of malnutrition on development assessed by Piagetian Tasks. Acta Paed. Scand, 1989; 78:115-122.

75. Nokes C. Grantham-McGregor S. M. Moderate to heavy intensity of Trichuris trichiuriasis affected cognitive function in Jamaican school children. Parasitology 1992; 104: 539-547.

76. Nokes C. et. al. Geohelminth infection and academic assessment in Jamaican children. Transac. Roy. Soc, Trop. Med. Hyg. 1991; 85:272-273.

11. Appendices

Appendix I.

Table 1A . Total number of eligible students and number of selected students per grade, and grade section of both elementary schools' children of Teda, April 2000.

	Total study population(both schools)		Sample from both schools	
Grade	Grade's section	No. of students	Grade's section	No. of students
One:	1A	97	1A	97
	1.1 ¤	59	1.1	32
	1.2	58		
	1.3	52	1.3	52
	1.4	52		
	1.5	65	1.5	65
Two:	2A	44		
	2B	42	2B	42
	2.1	48	2.1	48
	2.2	43	2.2	43
	2.3	50		
	2.4 ¤	48	2.4	42
Three:	3A ¤	40	3A	20
	3.1	47		
	3.2	43	3.2	43
	3.3	50	3.3	50
Four:	4A	49	4A	49
	4.1	40	4.1	40
	4.2 ¤	38	4.2	18
	4.3	43		
Total	20	1008	14	641

¤ reserve section

Teda Elementary and Junior Secondary School had labelled the section(s) of grade one as 1A, grade two and its sections as 2A, and 2B, grade three and its section 3A, and grade four and its section 4A.
The rest sections labelled as 1.1, 1.2, 1.3, 1.4, and 1.5 for grade one and 2.1, 2.2, 2.3, and 2.4 for grade two, etc. were from Teda Elementary School.

Appendix II.

Part one. School record

Instruction:

Please write clearly and eligibly.

Name of recorder____Signature____

1. School's name: 1. Teda Elementary 2. Teda Junior

2. Pupil's full name:____

3. Pupil's : grade____ and section____

4. Pupil's age to the nearest year____

5. Pupil's sex____

6. Pupil's last semester total scores____

7. Pupil's last semester section rank____

8. Pupil's last semester average score____

9. How many days was the student absent from school during the last semester?---- days.

10. Student's repeating status at current grade 1. Repeater 2. Non repeater

Part two. Questionnaire interview about socio-demographic factors of students and their families

To be filled in by interviewers by asking primary school students who are upto 14 years of age and in grades 1-4.

Instruction

A. Please write clearly and eligibly

B. First tell to the interviewee that you are going to ask him/her questions about themselves and their families. And request her/ him to give exact answers after listing carefully the question/s. Then start asking the questions. Except the 24th question, each question has only one correct answer among the given choices, so you should have to circle the correct response, and if the question is open-ended, and a response referring numeral or other thing is provided then you have to write that number or response in the space provided with (ink) pen.

Name of interviewer____signature

Name of student____

Student's age____

Student's A. Grade____ B. Section____

11. Student's sex 1. Male 2. Female

12. Residence 1. Town 2. Rural

13. With whom do you live?

1. With my father and mother
2. Only with my mother(because she has no husband)
3. With my mother and stepfather
4. Only with my father(because he has no wife) 5. Other(specify)____

14. What is your birth order?_____

15. Do you have radio? 1.Yes 2. No

16. Do you have television set? 1. Yes 2. No

17. Whose property is the house in which you live?

1. Our own 2. Kebele's

3. Of the Organization of government rent house

4. I do not know 5. Other(specify)____

18. Of what material is your house roof?

1. Corrugated iron sheets 2. thatched 3. I do not know

4. Other(specify)____

19. Of what material is your house floor?

1. Cement 2. Earthened 3. I do not know 4. Other(specify)____

20. How many rooms does have your house?____

21. Is there electricity in your house? 1. Yes 2. No

22. How many persons do live in your house?____

23. Do you have a kitchen (separate) from your house? 1. Yes 2. No 3. Other (specify)____

24. From where do you get your drinking water ? (one or more than one answers are possible, circle all the given answers?

1. From our own tap 2. From Kebele tap

3. From private tap 4. From protected/ cleaned spring/well

5. From unprotected/ uncleaned spring/well

6. From river/stream 7. From other/s(specify)____

25. Do you have latrine? 1. Yes 2. Know 3. Other(specify)____

26. If the answer for the above "25th" question is yes, then whose property is the latrine?

1. Our own 2. Shared with neighbour 3. Public 4. Other (specify)____

27. How do you dispose of your house waste?

1. Into municipality's or Kebele's bin 2. Into our own waste pit 3. On the open field

4. Other(specify)____

28. What is your father/ male caretaker's occupation?

1. Farm 2. Trade 3. Daily laborer 4. Government employee

5. Private employee 6. Other(specify)____

29. What is your mother/ female caretaker's occupation?

1. House wife 2. Housemaid 3. Trade 4. Daily laborer 5. Other(specify)____

30. What is your ethnicity? 1. Amhara 2. Tigre 3. Ormo 4. Other(specify)____

31. What is your mother education level?

1. Unable to read/write 2. Able to read/ write 3. Grades 1-6 4. Grades 7-12

5. Beyond 12 grade 6. Other (specify)____

32. What is your father education level?

1. Unable to read/write 2. Able to read/ write 3. Grades 1-6

4. Grades 7-12 5. Beyond 12 grade 6. Other (specify)____

33. What is your family religion?

1. Orthodox Christian 2. Muslim 3. Others(specify)____

34. Do you always wash your hands before you eat? 1. Yes 2. No 3. Other(specify) ____

Part three. Medical history and educational obstacles questionnaire interview

To be filled in by health assistant by interviewing students.

Instruction

A. Please write clearly and eligibly

B. First tell to the interviewee that you are going to ask him/her questions about diseases and symptoms which they have experienced. And request her/ him to give exact answers after listing carefully the question/s. Then start asking the questions. Each question has only one correct answer among the given choices, so you should have to circle the correct response with (ink) pen. For the open-ended questions write the given response in the space provided also with (ink) pen.

35. Have you been sick since last September?

    1. Yes 2. No 3. Other(specify)____

36. If the answer for "35th" question is yes, then(ask) have you had:

    1. Diarrhea? 1. Yes 2. No

    2. Lung tuberculosis? 1. Yes 2. No

    3. IPIs? 1. Yes 2. No

    4. Malaria? 1. Yes 2. No

    5. Whooping cough/ measles ? 1. Yes 2. No

    6. Others(specify)?____

37. Since last September which of the following symptoms have you experienced?

    1. Vomiting? 1.Yes 2. No

    2. Abdominal cramp? 1. Yes 2. No

    3. Itching/ scabies? 1. Yes 2. No

    4. Easy tiredness? 1. Yes 2. No

    5. Insomnia? 1. Yes 2. No

    6. Anorexia 1. Yes 2. No

7. Hearing difficulty? 1. Yes 2. No

8. Vision difficulty ? 1. Yes 2. No

9. Dizziness? 1. Yes 2. No

10. Others(specify)?____

38. Since last September have you been treated for the above or other diseases or symptoms?

1.Yes 2. No 3. Other(specify)____

39. Do you always wear shoes? 1.Yes 2. No

40. Since last September, among the following which have been obstacles in your education:

1. Much workload at home/ out of home? 1. Yes 2. No

2. No light to study at home? 1.Yes 2. No

3. Educational material shortage(like exercise book, books, pen, others)? 1.Yes 2. No

4. Lack of family support/encouragement? 1.Yes 2. No

5. Own illness? 1.Yes 2. No

6. Family illness? 1.Yes 2. No

7. Easy tiredness with light study? 1.Yes 2. No

8. Lack of educational helper(tutor)? 1.Yes 2. No

9. Hunger? 1.Yes 2. No

10. Abdominal cramp? 1.Yes 2. No

11.Time not devoted to the study? 1.Yes 2. No

12. Others(specify)?____

8. scabies 1. yes 2. no

9. wearing shoes? 1. yes 2. no

10. other gross abnormality/ies(specify)____

Part six. Laboratory results of stool examination.

To be done by Lab. Techn.

Instruction:

Using the usual way of quantifying write your finding in the space provided.

44. Number of eggs/larvae per slide of

1. Ascaris____

2. Pinworm____

3. hookworm____

4. other/s(specify)____.

Appendix III.

Table 1B. Rating(scoring) of selected items to determine the SES of Teda primary school children, April 2000.

Item	Score
having own radio	1
having own house	2
having own television set	4
having own tap water	1
availability of/having latrine	1
availability of /having kitchen	1
living in/having a house of cemented floor	4
living in /having a house of corrugated iron sheet roof	1
living in /having a house of 2 rooms	1
living in /having a house of 3 or more rooms	3
father in trade occupation	1
Total	20

Declaration

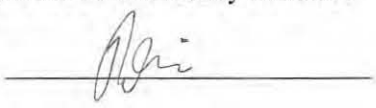
I, the undersigned, declare that this thesis is my original work, has not presented for a degree in this or any other university, and that all sources of material used for the thesis have been fully acknowledged.

Name: Belete Abebe (MD)

Signature : 

Date of submission: December 2000

This thesis has been submitted for examination with my approval as university advisor:

Fikru Tesfaye, MD, M PH 

Advisor's name Signature