LESSON 18

MALNUTRITION AND CHILDHOOD DISEASES

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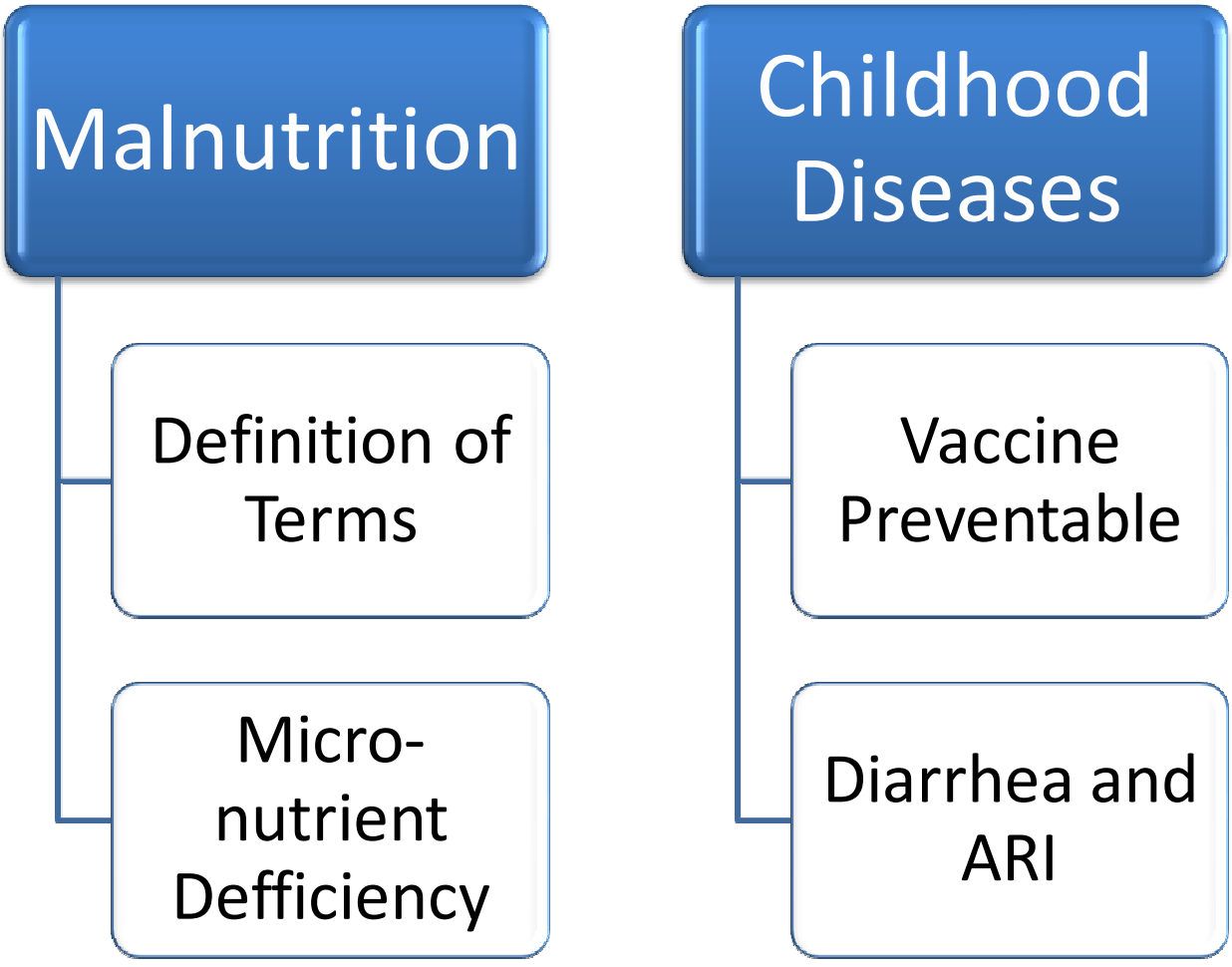
Learning Objectives:



Malnutrition and Childhood Diseases

MALNUTRITION

Introduction

Since the early 1970's the faces of starving Ethiopian children have been etched onto the consciousness of most caring Westerners and other donors of food and money. Several years later the international donors' and the current government's efforts to confront the problem of malnutrition among children are still continuing. On the plus side, Ethiopia is said to, now, have one of the most comprehensive disaster readiness programs in Africa to combat food emergencies, malnutrition, and famine. However, a joint venture with United Nations agencies "… regularly screens nearly half of its 14 million children under 5 for health and nutrition problems" [1] due to the continued dangers. More than half of Ethiopia's children are still chronically malnourished. Most do not die. "Some suffer a different fate. Robbed of vital nutrients as children, they grow up stunted and sickly, weaklings in a land that still runs on manual labor. Some become intellectually stunted adults, shorn of as many as 15 I.Q. points, unable to learn or even to concentrate, [and likely] to drop out of school early." [1]

As the New York Times article entitled "Malnutrition Is Cheating Its Survivors, and Africa's Future" observed, the consequences of childhood malnutrition are lifelong.

Estimates for 1992 put the proportion in the "malnourished" category at 52% [2, 3], and there is no proof that the situation has improved significantly since then. This is due, in part, to population growth resulting from the high fertility rates of the 1990s. On the contrary, all indicators point to a worsening of the nutritional status of children compounded by a series of famines that affected most of the country earlier this decade, continuing epidemics of infectious and parasitic childhood illnesses, worsening poverty, the ongoing global food crisis linked to the energy crisis, and sharp increases in standard of living as well as food consumption in Asia. Over 13 million Ethiopians were receiving food aid in 2003.

Three important indicators are commonly used to measure malnutrition:

Height-for-age,
Weight-for-age, and
Weight-for-height.

"Children whose measurements fall below two standards deviations from the reference median are generally considered malnourished. Each indicator captures different aspects of malnutrition." [3].

Definition of terms:

Stunting: Signifies low height for age, and is considered an indicator of chronic malnutrition. Height-for- age measurements track linear growth, with low scores indicating cumulative growth deficit. "Stunting is often the result of inadequate feeding practices over a long period and/or repeated illness. It is likely to persist even after these conditions are eliminated." [3]

> The height-for-age index measures linear growth retardation and cumulative growth deficit. Children who are below minus two standard deviations (-2SD) from the median of the reference population are considered short for their age, or *stunted*. Children who are below minus three standard deviations (-3SD) from the reference population median are *severely stunted*. Stunting of a child's growth may be the result of failure to receive adequate nutrition over a long period, or of sustained improper feeding practices, or of the effects of repeated episodes of illness. Height-for-age therefore represents a measure of the outcome of undernutrition in a population over a long period and does not vary appreciably with the season of data collection. [4]

Wasting: Refers to low weight-for-height and measures the body's mass in relation to body length. It is, generally, though to reflect the level of acute malnutrition. "As an indicator, wasting is likely to vary over short periods of time due to food availability and disease prevalence." [3]

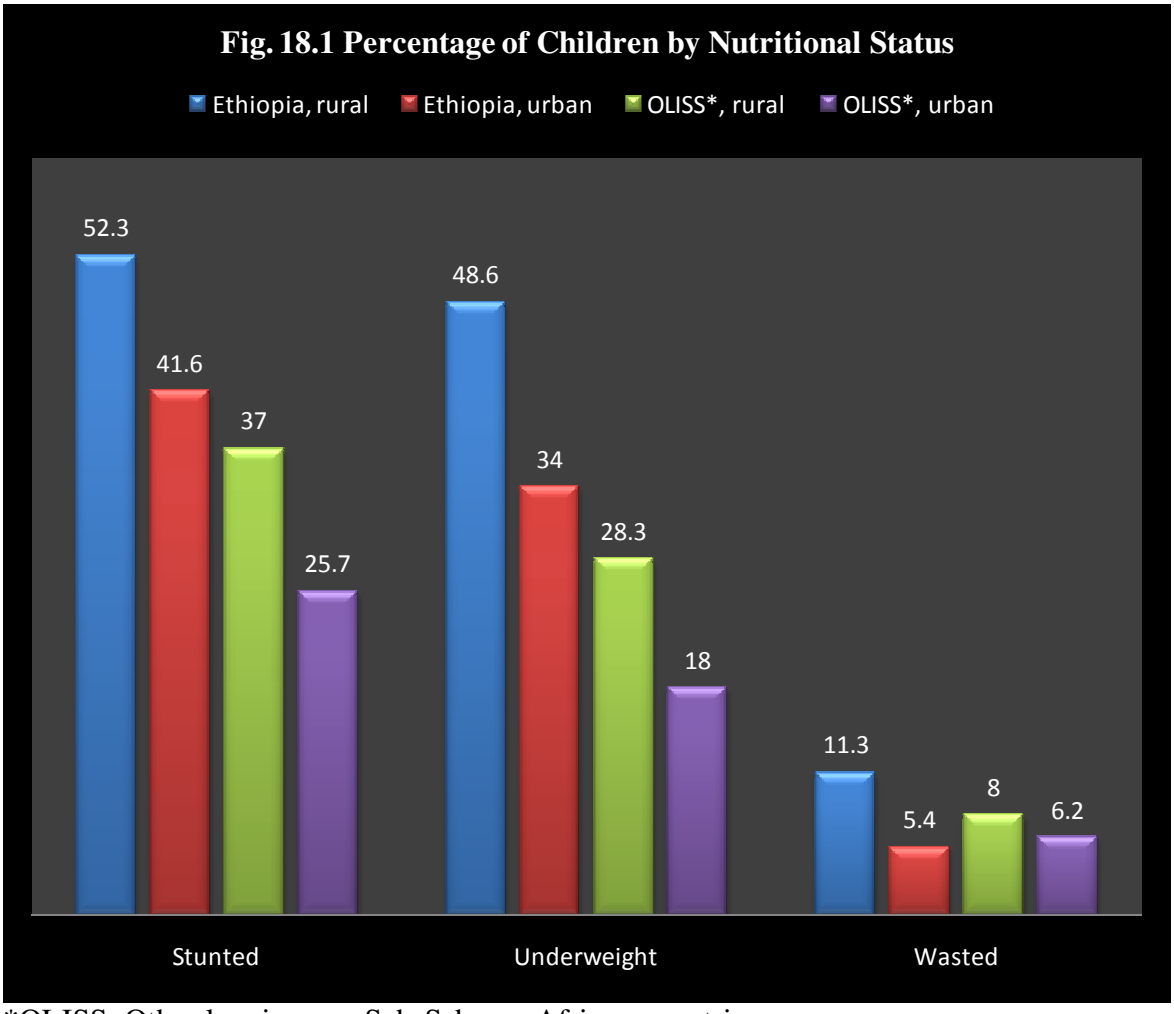
> "The weight-for-height index measures body mass in relation to body length, which shows current nutritional status. Children whose weight-for-height is below minus two standard deviations (-2SD) from the median of the reference population are too thin for their height, or *wasted,* while those who measure below minus three standard deviations (-3SD) from the reference population median are *severely wasted.* Wasting represents the failure to receive adequate nutrition during the period immediately before the survey and usually shows marked seasonal patterns associated with changes in food availability or disease prevalence. It may be the result of recent episodes of illness, particularly diarrhea; improper feeding practices; or acute food shortage." [4]

Underweight: Is a description based on weight for age, and is thought of as "…a composite of height for age and weight for height". Nutritionists use it as "… a general indicator of malnutrition, since a child that is underweight could be stunted or wasted, or both stunted and wasted". [3]

> Weight-for-age is a composite index of height-for-age and weight-for-height. Children whose weight-for-age measures below minus two standard deviations (-2SD) from the median of the reference population are *underweight* for their age, while those whose measurements are below minus three standard deviations (-3SD) from the reference population median are *severely underweight.* Being underweight for one's age therefore could mean that a child is stunted or wasted or both stunted and wasted. [4]

Urban-Rural Difference and Comparison to the Rest of Africa.

When it comes to childhood malnutrition, Ethiopia fares far worse than most other low income Sub-Saharan Countries (see Fig. 18.1) many of whom are themselves among the least developed countries in the world. This shows that Ethiopian children are enduring a level of nutritional deficit rarely seen anywhere else in the world. The data in Fig. 18.1 comes from the 2000 Demographic and Health Surveys (DHS) in Ethiopia and other Sub-Saharan countries.



*OLISS: Other low income Sub-Saharan African countries
Source: Based on [3]

There is a difference between urban and rural Ethiopia, with all indicators favoring urban children. The biggest marginal difference is in the "wasted" category where the proportions are more than twice as high in rural areas (11.3%) than in urban areas (5.4%). Even though the other countries of Sub-Saharan African counties considered here only covered those with lowest income categories (Burkina Faso, Cameroon, Chad, Cote d'Ivory, Ghana, Guinea, Kenya, Madagascar, Malawi, Mauritania, Namibia, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda,

Zambia, Zimbabwe), the differences in percentages of stunted and underweight children are substantial when compared to the percentages in Ethiopia. Ethiopia seems to fare slightly better in the third category "wasted" where the percentages are lower in urban areas of the country than the OLISS.

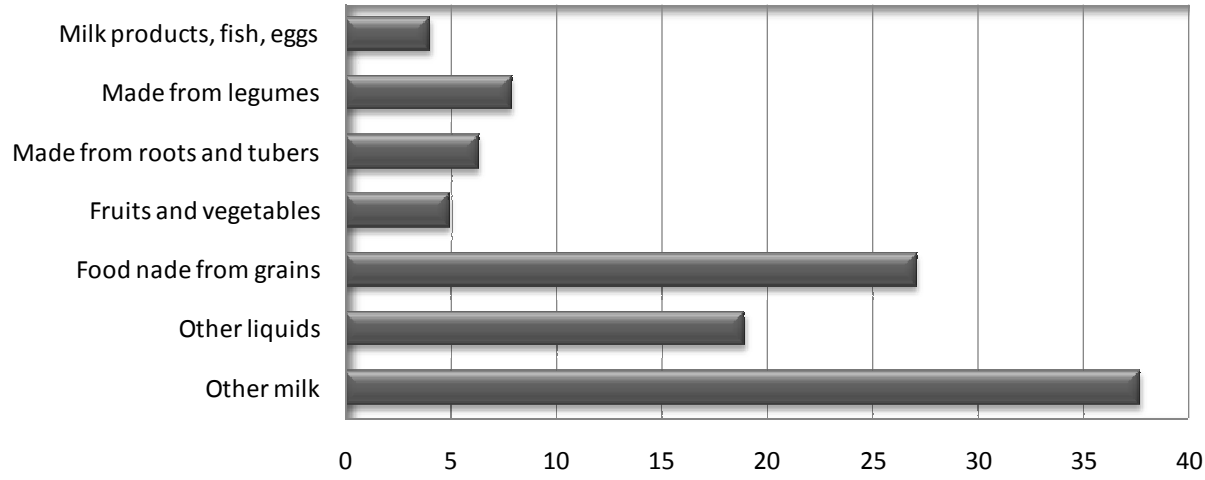
The year 2000 Ethiopian DHS survey looked at **maternal nutrition** and **infant feeding** in addition to **malnutrition among children**. The three are interconnected:

> "Maternal nutritional status has important implications for the health of mothers and children. Women in poor nutritional health face a greater risk of an adverse pregnancy and are more likely to give birth to children who are not healthy. Infant feeding practices are important determinants of children's nutritional status, and many studies have shown that breastfeeding has beneficial effects on the nutritional status of children and lowers morbidity and mortality among young children. Breastfeeding is also associated with longer periods of postpartum amenorrhea, which could extend birth intervals and lower fertility. A longer birth interval also provides mothers with the opportunity to fully recover before the next pregnancy and avert maternal depletion."[4]

Breastfeeding: With 96% of newborn babies breastfed at least for a short period of time, the practice is nearly universal in Ethiopia. Breast milk is uncontaminated and has antibodies that provide immunity against infections. Moreover, colustum – a chemical contained in the first breast milk – is highly nutritious, and the early suckling action by the baby stimulates the contraction of uterus and lessens maternal blood loss. Unfortunately, "contrary to the World Health Organization's recommendation of exclusive breastfeeding for up to the first 6 months of life, only 38 percent of Ethiopian children age 4-5 months are exclusively breastfed" [4]. The introduction of other foods raises the possibility of infection due to contamination with microbial agents.

Supplemental foods: Figure 18.2 shows the types of supplemental foods consumed by infants, by 6 to 7 months of age when, according to the WHO, they should still be exclusively breast fed. **"**The introduction of other liquids such as water, juice, and formula takes place earlier than the recommended age of about 6 months. Even among the youngest breastfeeding children (<2 months), 2 percent consumed other liquids, and 9 percent drank milk other than breast milk." [4] The introduction of other liquids increases with age, so that by 24-35 months of age a little more than half of the children (54 percent) are on liquid supplements.

Fig. 18.2 Pecentage of Infants Aged 6 -7 Months by Type of Supplemental Food Given

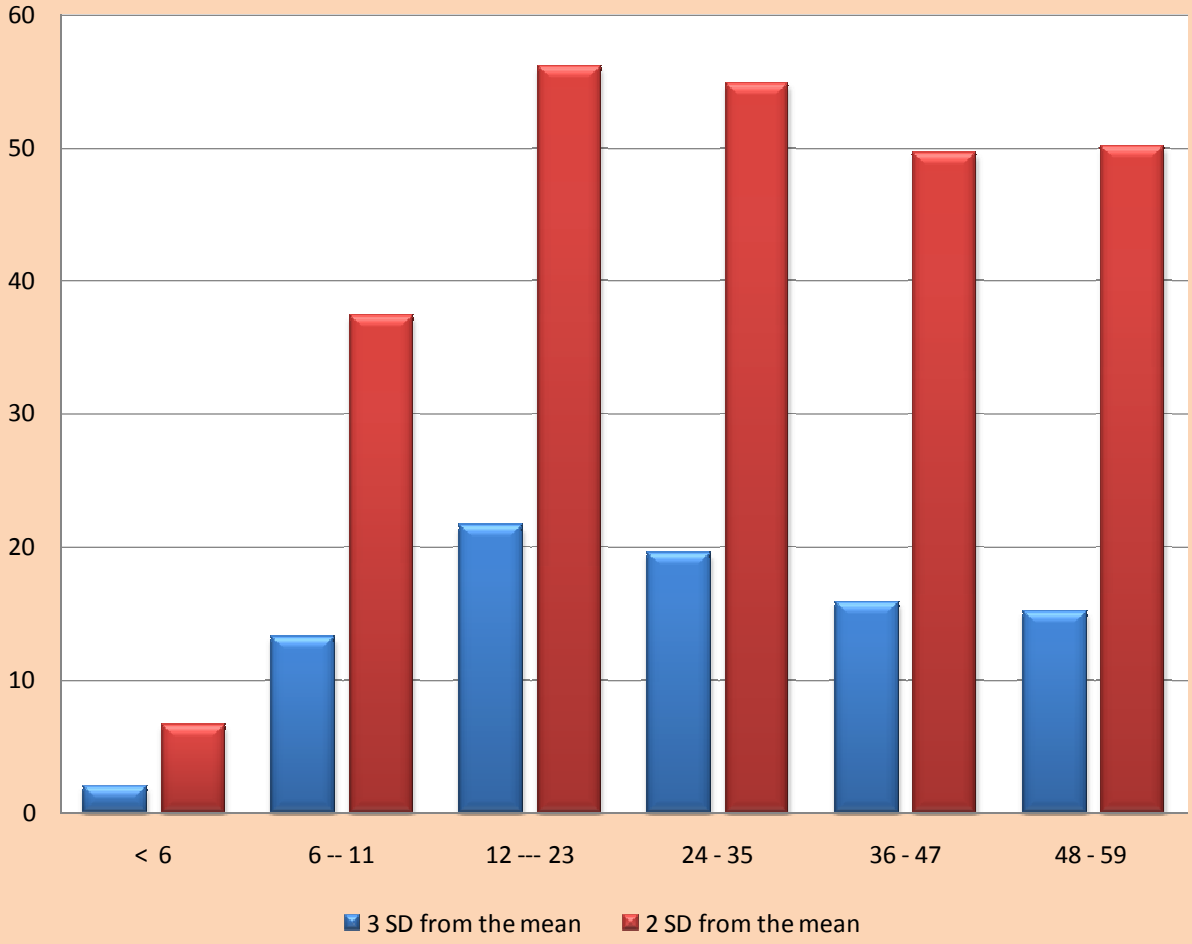


Source: [4]

> "About one in three children consumes some type of solid or semisolid food by 6-7 months of age. The percentage receiving solid or semisolid food increases gradually; by age two most children are fed solid or semisolid foods. Nevertheless, it is disconcerting to note that even at 6-9 months of age, only 44 percent of children are consuming solid or semisolid food. The majority of children consumed foods made from grains (59 percent). Only 28 percent of children under three years consumed vitamin A rich foods in the 24 hours preceding the survey. Meat, fish, poultry, and eggs have bodybuilding substances essential to good health and also contain nutrients that are important for balanced physical and mental development. The introduction of these foods in the diet is late, and very few children consume these foods." [4]

Figure 18.3 focuses on **weight for age** and proves the protective effects of breastfeeding and the consequences of premature introduction of solid foods and other liquids. Over a third of infants are already lagging in their weight (for height) by 2 standard deviations from the mean as early as age 6 to 11 months.

Fig. 18.3 Percentage of Children under 5 Years of Age with Weight for Age 2 and 3 Standard Deviations from the Mean by Age (in Months)



Source: [4]

Departure from mean, of **height for age**, has already been graphed and discussed in the introductory part of this online lesson. The proportion in this group approaches 60% in the 1-2-years age group where the proportion in the 3 standard deviations category is the highest.

As indicated above, chronic malnutrition among Ethiopian children is extremely high, with more than one in two children stunted; more than one in four are severely stunted. Moreover, it has been observed that "…the level of stunting increases rapidly with age from 11 percent among children under six months of age to about 60 percent among children age three years and older." [4]. The evidence from the 2000 DHS also showed that there is little difference in the level of stunting by the child's gender but significant difference by urban/rural residence. Expectedly, "…first order births are least likely to be stunted, and children of birth order 4-5 are most likely" which means that there is an inverse relationship between the length of birth intervals and stunting [4]. The protective effect of maternal education on the health of children has been recognized as an incontrovertible universal fact for some time now. In Ethiopia "… 33 percent of children of highly educated mothers are stunted, compared with 53 percent of children of

mothers with no education." [4]. "Wasting" is the most serious nutritional deficiency problem among Ethiopian children.

> Eleven percent of children under five years of age are wasted (thin for their height), and 1 percent are severely wasted. The proportion of wasted children is highest in the 12-23 month age group, which could indicate inadequate food supplementation during the weaning period and exposure to diseases. Wasting increases with birth order, as more children are likely to compete for a limited quantity of food, especially in poor households. Rural children are more than two times as likely to be wasted than urban children. Regional variation in the level of wasting is substantial. The level of wasting is highest in the Gambela Region (18 percent) and lowest in Addis Ababa. Mother's education has a positive impact on lowering wasting. Forty-seven percent of children are underweight (low weight-for-age) and 16 percent are severely underweight. [4]

MICRONUTRIENT INTAKE

A recently launched longitudinal study program by Young Lives International (an international study of childhood poverty) is expected to last more than a decade (2002 – 2015) and involves some 2000 children (each) in four countries – Ethiopia, India (Andhra Pradesh State), Peru and Vietnam – in which detailed surveys are conducted on nutritional status of children in the sample studies. Among the early findings in Ethiopia is the lack of sound government policy or action to effect changes and address the appalling state of childhood nutrition. In the words of the study authors [5] "…child malnutrition remains a major public health problem in Ethiopia, yet the government has no specific nutrition policy". As a result, "…child malnutrition in Ethiopia constitutes a particularly daunting challenge as the country had a 17 percent under-five mortality rate in 2001, of which an estimated 57 percent was linked to severe and mild to moderate malnutrition" [5].

Micronutrient deficiency is also among the very serious contributors to childhood morbidity and mortality. This relates to obtained foods, food fortifications, and supplements. Food supplementation is beginning to get acceptance, as donors and government institution begin to make it available to the wider public. The DHS asked mothers whether or not their children took vitamin A supplements in the last 6 months before the survey. The result showed that "…38 percent of Ethiopian children below five years of age consumed vitamin A through food in the seven days preceding the survey. Furthermore, more than one in two children (56 percent) received vitamin A capsules in the six months before the survey". The survey also found that 28% of children live in households with adequately iodized salt; and that,

> "…older children are much more likely to receive vitamin A supplements than younger children. There is no difference in vitamin A supplementation by gender and no clear pattern by birth order. Vitamin A supplementation is also low among breastfeeding children. The urban-rural difference in vitamin A intake is marked, with rural children much less likely to receive vitamin A capsules or foods rich in vitamin A. Children residing in the Affar Region are also least exposed to vitamin A supplements. Mother's education impacts micronutrient intake positively, with 76 percent of children of highly educated mothers, for example, having received vitamin A capsules in the six months before the survey, compared with slightly more than one in two children of mothers with no education. [4]

In the last three decades (and especially in this decade), children are being joined increasingly by adults in the diminishing capacity to fuel the body with enough daily calorific intake as well as micronutrient intake. The intake of both has dwindled in Ethiopia following the draughts of year 2000 and 2003 as well as the ongoing astronomical rise in food prices which prompted the May 2008 conference involving the heads of states of 181 countries.

> Ethiopia is not alone in suffering through the worldwide food crisis, which is threatening to push up to a billion people across the globe into hunger. ….A U.N. summit of 181 countries pledged to reduce trade barriers and boost agricultural production to combat rising food prices…Drought is especially disastrous in Ethiopia because more than 80 percent of people live off the land. Agriculture drives the economy, accounting for half of all domestic production and 85 percent of exports….The U.N. children's agency has characterized this year's food shortage -- in which an estimated 4.5 million people are in need of emergency food aid --as the worst since 2003, when droughts led 13.2 million people to seek such aid. In 2000, more than 10 million needed emergency food. [5]

Other causes

The causes of micronutrient deficiency and malnutrition in general are many. Major determinants often cited in literatures on the subject include socio-economic determinants, and biological factors relating to birth intervals and birth order. Regarding the latter two, the report from Young Lives study based on an Ethiopian sample of 1,762 one-year-olds from twenty sentinel sites, observes:

> When pregnancies are closely spaced, it is often the case that the mother will have little time to regain lost fat and nutrient stores … Child nutritional status is also expected to improve with higher birth spacing as the mother would get enough time for care and feeding. Studies showed that in most countries where DHS surveys have been conducted, children born less than 24 months after the previous child was born (a short birth interval) have a higher level of stunting…Parents are expected to give less attention to older children when there is a new child who needs much attention and care. Studies have shown that stunting is rare in lower birth orders (2-3) and that higher birth order (5+) is positively associated with child malnutrition…." [6]

Other Relevant Factors

Other observations contained in the "Young Lives" report and used here as an opener to the next section on childhood diseases include the following:

- Forty percent of the one-year-olds studied were underweight and 38% were stunted. A further 14% were wasted. "The proportions of children in urban areas that are underweight, stunted and wasted are 29, 29 and11 percent respectively, while the corresponding figures for rural areas are 50, 44 and 17 percent."

- "The average birth order of a child is 3.1 with the figure for rural areas being higher (3.45) than for urban areas (2.64), indicating, as expected, the larger average number of children in rural families."

- Females are the exclusive caregivers in (99.5 percent) even though 86% of the households are headed by males. The mean age of the care giving mothers was 28, and 12% have paid employment.

- The mean age of schooling for mothers and fathers was 2.6 years.

- Nearly two-thirds of urban households and 24% of rural households owned a radio; all TV sets were owned by urban households.

- Nearly half (46%) of the households obtain water from unsafe sources.

- A combined (urban and rural) 39 percent of the households use pit latrines or flush toilets; the percentage is much smaller in rural (15%) than urban areas (72%).

- "The two most frequently reported ailments that the children in the sample suffered from during the 24-hour period before the survey were diarrhea and fever, both known to be associated with child malnutrition".

- For mothers the average number of antenatal care visits was an extremely low 2.16 visits per pregnancy and the average in rural areas - 1.36 – is less than half that in urban areas – 3.3.

- Nearly one in five children in the sample households were born at a health facility; 40.1 percent in urban areas and only 3.1 percent in rural areas.

- "Some 12 percent of the children in the sample were cared for by children under five for some time" – 15% in rural areas and 7.2% in rural areas.

- Nearly three quarters of the children received BCG (bacille Calmette-Guérin) vaccination as protection against tuberculosis and 57.6 percent of were vaccinated against measles. Once again, these percentages were lower in rural areas.

- Roughly 60% percent of urban residents travelled less that 10 km to health centers. Only 46% of rural residents "enjoyed" a walking distance of less than 10km. The remaining 54% had to travel more than 10km.

- Boys in the study sample are "… more likely to be wasted, stunted and underweight…[due] to possible genetic differences between male and female children".

- Due, possibly, to protracted and irregular breastfeeding and/or inappropriate weaning customs, the oldest of the 6 to 18 month-old children included in the sample "… were found to be more malnourished (wasted, stunted and underweight), in both urban and rural areas".

- Mot mothers knew the importance of washing hands before food preparation and feeding but frequently could not afford to buy soap.

- Most female respondents regarded access to contraception to ensure family spacing, longer breastfeeding, and the provision of sufficient food as a necessary condition to better their children's health.

- "In the case of infant diarrhea caregivers often first seek out traditional healers. They recommend practices to ward off the "evil eye", extraction of milk teeth and the uvula. These may at best have no impact, or in other cases aggravate the child's health problems, either through direct intervention or delay of medical treatment."

- The crucial importance of women's empowerment and status as well as access to money and its linkages to child health is evidenced in the finding that those with "…at least some control over household income and/or access to credit in their own name are better able to address their children's dietary and healthcare needs."

- "While traditional health providers may offer useful complementary services in some areas of health behaviour, the practices they advocate in the case of malnutrition are clearly unhelpful."

Change Over Time

Not much is known about recent changes in childhood nutritional status. Some insight has been gained, however, from the report by the year 2005 Demographic and Health Survey (DHS) which made a passing reference to two areas of change in nutritional status of children; namely, a 5%, and 9% decrease in the proportion of stunted and underweight children respectively, as well as a slight decline in the number of months of exclusive breastfeeding. The proportion of infants aged 0 to 5 months already taking supplemental foods grew from about 5 percent in 2000 to more than 10 percent in 2005.

Childhood Diseases

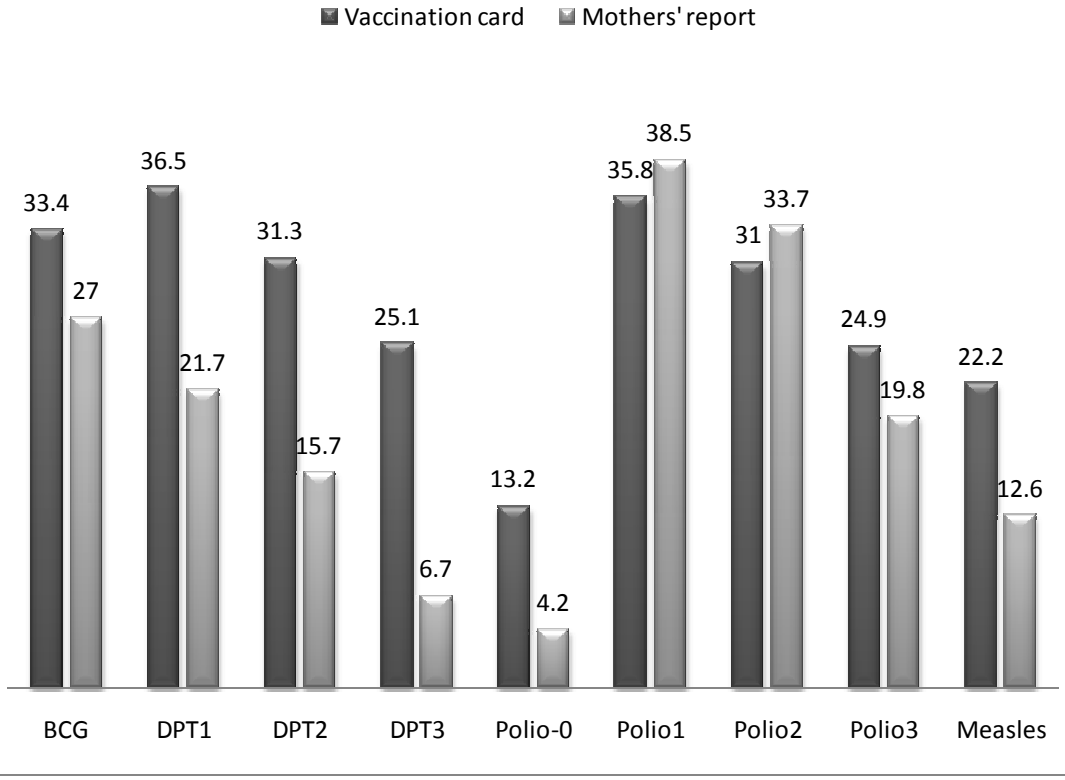
Vaccine Preventable

Ethiopia launched its so called expanded program of immunization (EPI) in 1980. The word 'expanded' was used in reference to the plan to increase the number of antigens in a vaccine from two to six, and vaccination coverage from five percent to a hundred percent [8]. The goal of a universal coverage was to be achieved through a 10% annual increase. Two decades later, the result of this effort is being deemed unimpressive because "although some *weredas,* especially those in urban areas, were able to achieve high coverage levels in the past decade, the achievement of EPI at the national level have not been satisfactory" [8]. Some gains were made between the year 2000 and 2005 DHS surveys. Coverage among children aged 12-23 months increased somewhat with the percentage of the fully immunized growing by 43 percent from a very low base of 14% in 2000 to 20% in 2005 [7]. However, the percentage of children in this age category who received no vaccination at all also increased (from 17 percent in 2000 to 24 percent in 2005), and there are significant differences in the subgroup of the population who have, or have not received vaccination. The World Health Organization (WHO) defines full coverage as a program in which all children receive vaccination against "…tuberculosis (BCG), three doses each of the DPT and polio vaccines, and a measles vaccination by the age of 12 months. BCG should be given at birth or at first clinical contact, DPT and polio require three vaccinations at approximately 4, 8, and 12 weeks of age, and measles should be given at or soon after reaching 9 months of age". [7]

"Twenty percent of children age 12-23 months had been fully vaccinated at the time of the [2005] survey. Three in five have received the BCG vaccination, and 35 percent have been vaccinated against measles. The coverage for the first dose of DPT is relatively high (58 percent). However, only 32 percent go on to receive the third dose of DPT. Polio coverage is much higher than DPT coverage because of the success of the national immunization day campaigns during which polio vaccines are administered. Nevertheless, the dropout between the first and subsequent doses of polio is marked – a 40 percent decline between the first and third dose. Vaccination coverage in Ethiopia has improved over the past five years." [7]

The data on vaccination coverage was collected both from vaccination cards shown to the interviewer, and from mothers' verbal recollections. The latter, obviously, is a less reliable method but forms a smaller proportion of all vaccine reports except Polio1 and Polio2.

Fig. 18. 4 Percentage of Children 12-23 Months who Received Vaccines by Source of Information



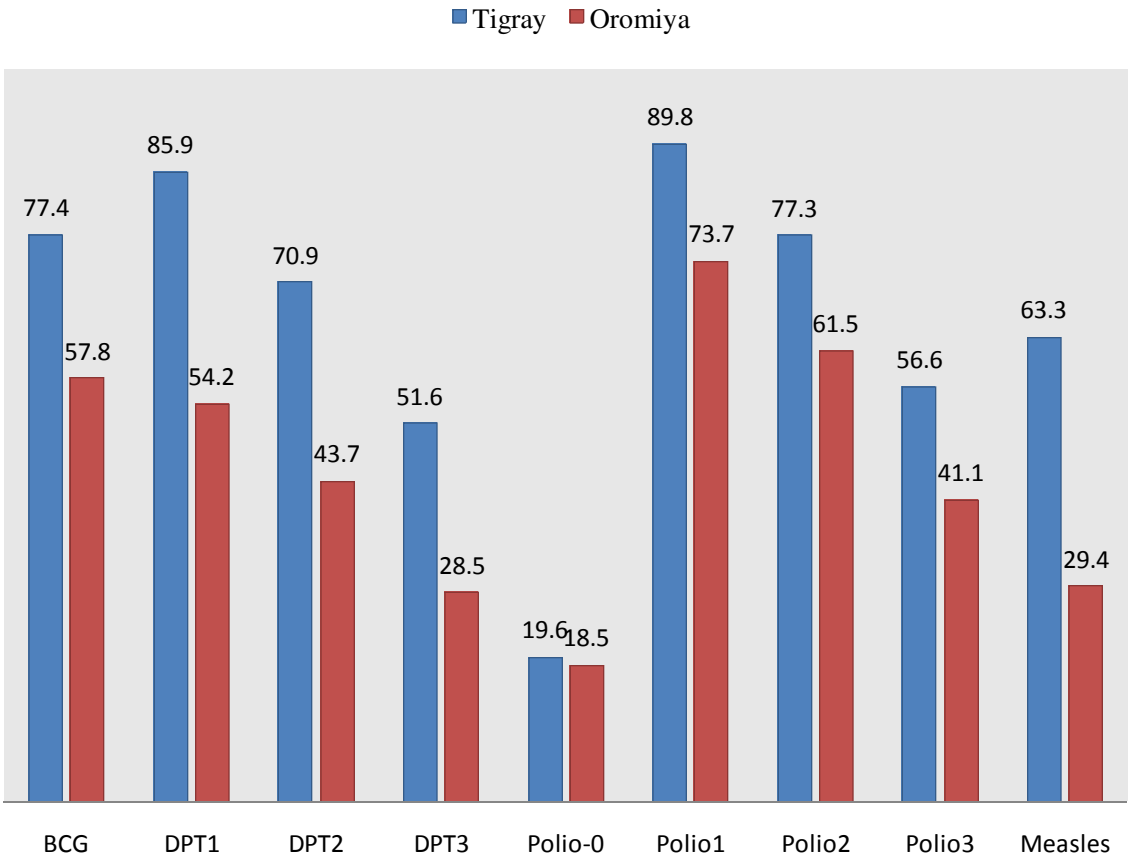
Source: Based on [7]

Analysis of differentials among population groups reveals that [7]:

- Slightly more boys than girls have been vaccinated.

- Significantly higher children in urban areas than rural areas were vaccinated.
- Women with secondary or higher education vaccinated their children at significantly higher rates than women with no education; the ratio is two to one when all vaccines are taken together.
- Expectedly, relative wealth is an important determinant of the likelihood of vaccination coverage with women in the highest wealth quintile having a more than two to one advantage when the fully vaccinated children are considered separately.
- Spatial/regional differences also favor the predominantly urban regions of Addis Ababa and DireDawa as the most complete coverage areas, but Tigray is close behind despite its predominantly rural character - a clear sign of the continuing evidence of its health care advantage noted in lesson 14. A comparison is made with the most populous region - Oromiya - in Fig. 18.5. Similar patterns emerge when other regions are matched up against Tigray.

Fig. 18.5 Percentage of Children 12-23 Months old in Tigray and Oromiya by Type of Vaccination Given



Source: Based on [7]

The highest percentage difference for vaccine coverage between Tigray and Oromiya is for measles (63.3% vs. 29.4%), and the lowest is in the initial polio vaccine (given at birth).

Measles

The number of measles cases in Ethiopia is estimated to be 1.45 million per year with 72,000 deaths among children. One is five children with measles die of its complications including pneumonia, diarrhea, encephalitis and respiratory problems. [9]

> "Measles is probably the commonest of vaccine preventable diseases that occur in Ethiopia….Although [it] is one of the weekly reportable diseases in Ethiopia the number of reported cases represents only a small proportion of the expected cases. Measles cases usually come late to the health facilities and often after they have developed complications. As a result the diagnosis given by the health workers tends to be one of its complications rather than measles itself…." [8]

The Disease Burden

According to the WHO [10] :

- Despite the availability of highly effective and safe vaccines, measles has been a leading cause of morbidity and mortality among young children in the past 40 years.
- The year 2006 estimate of measles mortality was 242,000 deaths globally (see Fig. 18.6) which translates into 27 deaths hourly, or about 663 deaths daily.
- Countries with per capita GDP of US$1000 or less account of more than 95% of measles deaths reflecting the link between development and rates of measles morbidity and mortality.
- Measles immunization represents an inexpensive method of preventing human suffering as well as complications of, and death from, the disease.
- Accordingly, vaccination has had a major impact on measles deaths globally, with measles mortality down by 68% between 2000 and 2006. The largest and most significant gains took place in the African continent where measles cases and deaths fell by 91%.
- "Global Immunization Vision and Strategy (GIVS) calls on countries to reduce global measles deaths by 90% by 2010 compared to 2000 estimates. WHO and UNICEF have developed a comprehensive strategy to sustainably reduce measles deaths."

The Agent

Measles, also called rubeola, is a highly contagious infection caused by the paramyxovirus of the genus *Morbillivirus*. [11]. It causes a total-body skin rash and flu-like symptoms, including a fever, cough, and runny nose.

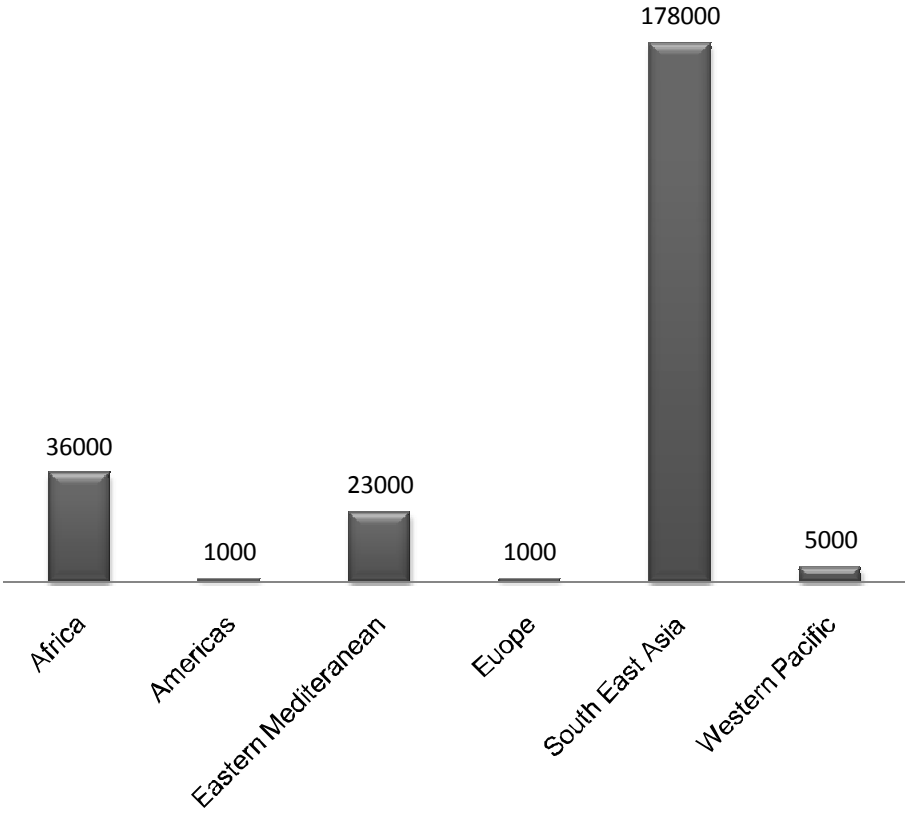
> The first sign of infection is usually high fever, which begins approximately 10 to 12 days after exposure and lasts one to seven days. During the initial stage, the patient may develop a runny nose, cough, red and watery eyes and small white spots inside the cheeks. After several days, a rash develops, usually on the face and upper neck. Over a period of about three days, the rash spreads, eventually reaching the hands and feet. The rash lasts for five to six days, then fades. The rash occurs, on average, at day 14 after exposure to the virus, with a range of seven to 18 days.

The most serious complications include blindness, encephalitis (a dangerous infection of the brain causing inflammation), severe diarrhoea (possibly leading to dehydration), ear infections and severe respiratory infections such as pneumonia, which is the most common cause of death associated with measles. Encephalitis is estimated to occur in one out of 1000 cases, while otitis media (middle ear infection) is reported in 5-15% of cases and pneumonia in 5-10% of cases. The case fatality rate in developing countries is generally in the range of 1 to 5%, but may be as high as 25% in populations with high levels of malnutrition and poor access to health care. People who recover from measles are immune for the rest of their lives. [10]

Global Impacts

Measles is now a rare disease in many industrialized countries, but remains a common illness in many developing countries and underdeveloped countries. The WHO estimates the number of people infect each year at more than 20 million. [10]

Fig. 18.6 Annual Measle Mortality by Region



Source: Based on [10]

Due to its large population size, Southeast Asia has by far the highest number of measles cases and measles mortality, followed by Africa and the Eastern Mediterranean region.

Polio

According to the 2005 UNICEF news report on polio in Ethiopia, " …once on the verge of being polio-free, Ethiopia fell victim to the recent polio outbreak originating in West Africa, which quickly spread to 16 countries across the region. Since the beginning of 2005, 13 Ethiopian children have been infected." [12]

Poliomyelitis is, perhaps, the most intensely watched disease in Ethiopia, having been targeted for eradication in 1997. Three reasons are given for the belief that the disease can be eradicated in Ethiopia: a) humans are the only hosts (no animal reservoir), b) highly effective vaccine exists, and c) a lifelong immunity is achieved after the initial infection [8].

Infection rates as varied as 7.3 per 1000 (Gonder), 2.1 per 1000 (Gonder a decade later), have been noted in the few studies on the subject. The urban-rural ratio on cases was 60/40 and more male (55%) than female patients were found in the studies. [8]

The Disease

Polio infects mainly children under five years of age. In the majority of polio cases (about 95%) polio infection causes no symptoms or ill health effects. In the remaining 5% of polio cases the manifestations are either a mild form (abortive polio) with flu-like symptoms, or a nonparalytic form (aseptic meningitis), or a severe form called paralytic polio. People who have minor or nonparalytic forms recover completely. [13]

> " In paralytic polio, the polio virus invades the central nervous system -- the spinal cord and the brain -- and may cause weakness, paralysis, serious breathing problems or death. Paralytic polio begins like milder forms of polio, however, it usually causes severe muscle pain in addition to other symptoms. Paralysis usually happens within the first week. The individual may lose the ability to use of one or both legs, arms, and may not be able to breathe without the help of a machine. Recovery varies from person to person, but people who are paralyzed by polio will have some weakness in an arm or leg for the rest of their lives." [13]

For centuries, isolated cases of "infantile paralysis" had occurred in many parts of the world (even as far back as ancient Egypt). However, doctors did not describe polio's distinctive damage to the spinal cord until about 1860. They gave the disease its scientific name, "poliomyelitis" - inflammation of the grey matter of the spinal cord - in 1874. Initially, there wasn't a direct evidence that the disease was contagious. The post-war World War II years "… saw polio epidemics occur more often, strike more severely and in more parts of the world than ever before." The regions affected included "… Central Europe, the United Kingdom, parts of South and Central America, the Middle East, the Soviet Union and Asia, and even the Canadian Arctic during the winter, were severely stricken by polio for the first time during this period…." [14]

The Agent

Polio is caused by the human enterovirus which is a member of the family of Picornaviridae. There are three serotypes of poliovirus, *PV1, PV2, and PV3*. While PV1 is the most common form encountered in nature, all three forms are extremely infectious [15]

Global Impacts

One in 200 polio infections lead to paralysis (and death among 5 to 10% of those that are paralyzed) but there is good news on polio. Globally, the incidence of polio has decreased by 99% since 1988 "…from an estimated 350,000 cases then to 1997 reported cases in 2006". In the year 2008 only four countries – Nigeria, India, Pakistan, Afghanistan - remain endemic (down from more than 125 in 1988) [16]. The world needs to remain vigilant, however, because between 2003 and 2005 "…25 previously polio-free countries were re-infected due to imports of the virus" [16].

Diarrhea

Common misspellings include: "….diarhea, diahrea, diahrria, diarreah, diarrea, diareah, diahrrea, diarreha, diareha, diarea, diahhrea. Diarrhea is defined as "a familiar phenomenon with unusually frequent or unusually liquid bowel movements, excessive watery evacuations of fecal material…". [17]. Continuous and persistent diarrhea "….is both uncomfortable and dangerous to the health, as it can indicate an underlying infection. It may also mean that the body is not able to absorb some nutrients due to a problem in the bowels." [17]

Diarrheal illnesses are common and widespread in Ethiopia. They are "…the second leading cause of death among children under five years of age". Moreover, "during periods of draught and/or famine, acute childhood diarrhea becomes the leading cause of death across all ages in Ethiopia" [18]. Larson, Sileshi, and Tigist [18] estimated the number of yearly childhood deaths in Ethiopia attiributable to diarrhea at 95,000 based on an overall under-five mortality rate of 170 deaths/1000 and the assumption that 20% of those are caused by diarrhea. Based on the survey of available literature and past studies, they also noted that the prevalence rate for diarrheal infections around the country varied from 11.4% to 37% (see table below). These numbers need to be viewed cautiously, however, and they should, by no means, be taken as a representation of the national picture on diarrheal illnesses.

Survey location	Year	Prevalence rate	Sample size (all are children)
Jimma	1994	26.3	175 (rural)
Jimma	1996	37.0	820 (urban)
Gonder	1997	18.0	1,101 (rural + urban)
Jimma	1998	33.7	848 (rural)
Dabat	2000	11.4	457 (urban)

Source: [17]

Past studies suggested "… a two-third and one-third breakdown between acute childhood diarrhea (ACD) and persistent childhood diarrhea (PCD)…The ACD/PCD ratio is important to monitor because of the greatly increased risk of death in children with PCD. PCD accounts for about one-third of all diarrhea deaths in Sub-Saharan Africa". Moreover, In Ethiopia, as elsewhere, "HIV infected children are known to be at increased risk of diarrheal disease". [17]

The 2005 Demographic and Health Survey (DHS) in Ethiopia collected national data on diarrheal prevalence, and reported the following results [7]:

- Nationally, 18 percent of children under-five years of age had diarrhea in the last two weeks before the survey; 6 percent had blood in their diarrhea.
- Twenty percent of children with symptoms were taken to a health provider
- Oral rehydration therapy (ORT) was given to just over a third (37%) of children with symptoms
- Roughly half of children sick with diarrhea were given no treatment at all.
- Prevalence of diarrhea varies seasonally
- Among children under-five the highest percentage reporting diarrheal illnesses in the two weeks before the survey was in the age group of 6 – 11 months (29.3), most likely due to improper weaning and/or unhygienic feeding practices, and 12–23 months (28.3), followed by those in the age group of 24–35 months (18.5%)
- Regionally, the data showed a prevalence of 11 to 19 percent except in Benishangul Gumuz and SNNP where more than one in five children had diarrhea within the last two weeks before the 2005 DHS survey (21.3% and 25.1% respectively).
- Children of mothers with no education are twice as likely as those born to mothers with secondary schooling or above to have come down with diarrhea in the last two weeks before the survey. Likewise, much higher percentages of children of mothers with secondary+ education (44.6%) than children of uneducated mothers (18.9%) were brought to medical institutions for treatment.
- The highest percentage of children who were taken to a health institution varied from 40% and above in Gambella and Addis Ababa, to single digit percentages in Afar and Somali.

The Agents

During normal digestion, the food consumed remains in liquid form during most of the digestive process. "When the unabsorbed food residue passes through your colon, most of the fluids are absorbed and what remains is a semisolid stool." [19]

Diarrhea is, therefore, a case in which the food and fluids in the digestion process "… pass too quickly, or in too large an amounts (or both) through [the] colon". The fluids in the digestive tracts are not absorbed sufficiently, leading to a watery bowel movement. Moreover, the lining of the colon may be inflamed or infected, making it incapable of absorbing fluids.

The most common causes of diarrhea include:

Causes	Examples
Viral infections	Rotavirus, Norwalk virus
Bacterial infections	E. coli, Vibrio cholerae, Campylobacter, Shigella
Parasites	Giardia, Entamoeba
Helminths (intestinal worms)	Strongyloides
Allergic	Lactose intolerance, celiac sprue, medication side effects
Autoimmune	Ulcerative colitis, Crohn's disease
Malabsorptive	Pancreatic deficiency, biliary disease
Nutritional	Zinc deficiency, vitamin A deficiency, enteral feedings consisting of liquid nutritional formulas delivered straight to the bowels
Functional	Irritable bowel syndrome, short bowel syndrome, cancer

Source: [20]

Global Disease Burden

WHO estimates put the annual number of acute diarrheal cases afflicting the world population, especially children in developing countries at 4 billion, and 2 million children, mostly in the age

group of 6-36 months die from it [21] The overall death (adults +children) is estimated at 3.5 million a year. Children are most vulnerable because even a small amount of fluid loss can result in significant dehydration due to fewer internal resources, and higher energy requirements. [20]

Acute Upper Respiratory Infections

A literature review of available works on acute respiratory infections (ARI) among children in Ethiopia [22] gave the following summary:

- ARI accounts for over 30% of the causes of morbidity and mortality among Ethiopian children.
- ARIs account for 27.2 percent of outpatient visits, 29.1 percent of admissions to a hospital, and 39.8 percent of hospital deaths (all due to pneumonia).
- The 2000 Demographic survey showed a very high prevalence rate among infants aged 6-11 months (33%) with greater likelihoods of infection among rural children, and among those born to uneducated mothers.
- Ethiopian children suffer from four to eight episodes of acute respiratory infections per year
- "The colonization of the respiratory tract of children harboring potential pathogens is universal, with 85% of the world's children harboring *H. influenza*, 83% *M. catarrhalis*, and 90% *S. pneumonia* in the naso-pharynx"
- For Ethiopian children and adults, the risk factors for include use of biomass fuel for cooking, lack of a separate bedroom from the kitchen, indoor air pollution , lack of functional windows for proper ventilation, malnutrition, and age.

The 2005 Ethiopian Demographic and Health Survey solicited information on ARI by asking mothers whether or not their children (under age five years of age) had been ill with cough accompanied by short, rapid breathing in the two weeks before the survey [23]. These are symptoms often associated with ARI. Unfortunately, this survey technique makes the responses subjective due, in part, to lack of validation by medical personnel. The findings from the survey include the following:

- Thirteen percent of children under-five showed symptoms of ARI in the two weeks preceding the survey.
- For children under five, prevalence varied by the child's age with highest prevalence among 5-11-month-olds, and the lowest among those aged 48-60 months.
- Four regional states had double digit prevalence – Tigray, Oromia, SNNP, Gambella – and the rest had single digit prevalence rates.
- The lowest prevalence (2.4%) was recorded in Dire Dawa.
- "Cough and rapid breathing were higher among children in rural areas (13 percent) than children in urban areas (9 percent)."
- Only 19% of AIR patients under five years of age were taken to a health care facility.
- The proportion of children under five who were taken to medical facilities varied with age; the highest percentages were for the 0-6-months and 12-23-months group.
- Only 5% of children under five with symptoms of ARI received antibiotics.
- Analysis of time-tends between the year 2000 and 2005 DHS showed an overall decline in ARI among children under five as well as a slight increase in the proportion of children who were taken to health care facilities.

Agents

Haemophilus influenzae

H. inflenzae is A coccobacillus (plural *coccobacilli*), which "… is a type of rod-shaped bacteria" The term *coccobacillus* "….is derived from *coccus* (spherical) and *bacillus* (elongated)" [24].

> "Naturally-acquired disease caused by *H. influenzae* seems to occur in humans only. In infants and young children (under 5 years of age), *H. influenzae* type b [Hib] causes **bacteremia** and acute bacterial **meningitis**. Occasionally, it causes **epiglottitis** (obstructive laryngitis), **cellulitis**, **osteomyelitis**, and **joint infections**. Nontypable *H. influenzae* causes ear infections (**otitis media**) and **sinusitis** in children, and is associated with **respiratory tract infections** (pneumonia) in infants, children and adults.." [25]

Moraxella catarrhalis

M. catarrhalis is A **diplococcus** (plural **diplococci**), which is "…a round bacterium (a coccus) that typically occurs in pairs of two joined cells" [26]

> "The most significant infections caused by *M catarrhalis* are upper respiratory tract infections, including otitis media and sinusitis in children and lower respiratory tract infections in adults. Infections with *M catarrhalis* in adults are more common if underlying conditions are present, especially in elderly persons. … Colonization of the upper respiratory tract with *M catarrhalis* ranges in different studies from 28-100% in the first year of life. In adults, a colonization rate of 1-10.4% has been observed. Colonization appears to be an ongoing process with an elimination-colonization turnover of various strains. Transmission is believed to be due to direct contact with contaminated secretions by droplets." [27]

Streptococcus pneumoniae

> "*Streptococcus pneumoniae* is a normal inhabitant of the human upper respiratory tract. The bacterium can cause pneumonia, usually of the lobar type, paranasal sinusitis and otitis media, or meningitis, which is usually secondary to one of the former infections. It also causes osteomyelitis, septic arthritis, endocarditis, peritonitis, cellulitis and brain abscesses. *Streptococcus pneumoniae* is currently the leading cause of invasive bacterial disease in children and the elderly." [28]

The term "strepto" refers to the fact that the bacteria "…grow in chains or pairs, hence the name — from Greek *streptos*, meaning easily bent or twisted, like a chain. Contrast this with staphylococci, which divide along multiple axes and generate grape-like clusters of cells". [28] The terms Cocci "….(singular - coccus, from the Latin *coccinus* (scarlet) and derived from the Greek *kokkos* (berry)) are any microorganism (usually bacteria) whose overall shape is spherical or nearly spherical." [29].

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