Factors Contributing to Child Malnutrition in Tigray, Northern Ethiopia

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Abstract

Objective: Estimate levels of and identify factors contributing to child malnutrition in Tigray, Northern Ethiopia.

Design: Cross-sectional survey

Setting: Rural communities from four zones of Tigray.

Methods

Three hundred and twenty one under five children were recruited from 587 randomly selected households. Household information and anthropometric measurements were collected. Multiple regression analysis and ANOVA were used for statistical analysis.

Results

The levels of stunting, under weight and wasting were 42.7%, 38.3% and 13.4% respectively. A very high proportion of the mothers (80%) initiated feeding of newborns with pre-lacteal feeds primarily butter or water. Family foods and cereal-based porridge were the main complementary foods after six months. Older children were more likely to be malnourished. Child age, maternal anthropometric characteristics, inadequate complementary foods, and area of residence were the main contributing factors to child malnutrition.

Conclusion

Malnutrition gets worse as the children grow older. The energy and nutrient density of the complementary foods are low as the foods were prepared from a limited number of local staple cereals without the addition of sugar, fat/oil or animal products. More importantly, these foods are diluted with water to reduce their viscosity. This makes the quality and quantity of the foods insufficient to prevent stunting. Sustained nutrition education programs focusing on appropriate complementary feeding practices are recommended.

Introduction

Of the nearly 1.9 billion children in the developing world, 31% are stunted (1, 2). Despite the continued progress in all the developing countries, it is still predicted that there will be 128-155 million underweight children by the year 2020 with 35% of these children to be from sub-Saharan Africa (3).

The most important documented forms of malnutrition in Ethiopia are protein energy malnutrition and vitamin A, iodine, iron and zinc deficiencies (4-8). Child malnutrition in Ethiopia constitutes a particularly daunting challenge as the country had a 17% under five mortality rate in 2001 of which an estimated 57% was linked to severe and mild to moderate malnutrition (9). The most recent national data showed that 41%, 42% and 11.6% of the under five children were below -2 Z-scores for height for age, weight for age and weight for height, respectively (10). These figures are among the highest in the world (2).

High rates of malnutrition can be attributed to both intrauterine growth retardation and post natal growth faltering (11). Though there is a lack of agreement about the relative importance of the factors affecting the nutritional status of children (9), the postnatal growth faltering in Ethiopia is largely caused by high rates of infection, limited household food availability, and poor infant feeding practices leading to inadequate energy and nutrient intakes (4,12).

Linear growth deficit is the most apparent sign of nutritional deficiency in children less than five years of age. The deficit begins in the first 4 – 6 months of postpartum life and is accentuated throughout the first 3 years of life. Between 3 and 5 years of age, the rate of decline decreases, but in many cases, compromised stature persists throughout the individual's life (13). Although many questions remain concerning the precise mechanism and magnitude of effects, there is now considerable evidence that malnutrition has effects on physical growth, morbidity, mortality, cognitive development, reproduction, physical work capacity and risks for several adulthood chronic diseases (14, 15).

Subjects and Methods

Socio-demographic information

A household questionnaire was used to collect socio-demographic information by interviewing mothers. Either the key caregiver to the child or the father were interviewed when the mother was absent during data collection. A pilot survey was conducted in a host community and problems highlighted during the pilot survey were corrected before the start of the actual survey.

Study subjects

Three hundred twenty-one under five children were recruited from randomly selected households from Central, Eastern, Northwestern and Southern zones of Tigray between October 2004 and January 2005.

Anthropometry

Age, sex, weight and height were recorded. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively. For children under two years of age, recumbent length measurement was taken. Each subject was weighed with minimum clothing and no foot wear. Age of each child was collected from the mother and counter checked using vaccination cards, baptismal certificates or other forms of informal recording. When these recordings were not available, a calendar of locally important

events was used. The 15th day of the month was used when the date of birth was unknown and if the month of birth was unknown, the midpoint of the year of birth was used. The Epi Info version 3.3.2 and the 1978 NCHS/CDC/WHO growth reference z-score system were used to calculate height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) z-scores. Children with HAZ, WAZ and WHZ below -2 were characterized as stunted, underweight and wasted, respectively. These variables were considered as the dependent variables during statistical analysis.

Ethical considerations

Prior to the actual data collection, the survey team made a short visit to the study communities to meet local administrators and community leaders and brief them on the purpose and importance of the survey. Community leaders' consent was obtained before starting data collection in a community and individual consent was obtained before starting the interviews or taking body measurements. For children, the consent was obtained from their mothers/care givers.

Quality control

The interviewers were trained to standardize the questionnaire administration and anthropometric measurements. All the interviewers were able to communicate in the local language. Daily close supervision (spot checks, re-interviewing and thorough scrutiny of filled-in questionnaires) was made by the field supervisors deployed with the data collectors. At the end of every community level data collection, meetings were held between data collectors, supervisors and the research team to discuss practical problems and issues of major concern. Subjects were re-interviewed when item non responses were encountered.

Statistical analysis

Data were analyzed using the Statistical Analysis System Software (SAS, version 9.1). Statistical analyses included descriptive statistics, Analysis of Variance (NOVA) and multiple regression. Statistical significance was set at $p < 0.05$.

Results

Indicators of child malnutrition were assessed against potential independent variables such as maternal characteristics, access to social services, complementary foods, breastfeeding practices, household and community characteristics.

All the households were from rural communities and made their living by farming and animal husbandry. Most (90%) of the mothers were illiterate and 68.9% reported that they had access to safe drinking water; however, 84% of the households had no latrine. Health service utilization for delivery was minimal as 95% of the mothers reported that they gave birth at home but 80% of mothers reported that they had access to family planning services. Almost all (96%) the mothers were married and 74% gave birth at the age of 20 or less. The mean age of first marriage and birth in the study area were 14.7 and 18 years, respectively. Surprisingly, the youngest marriage age reported was 7. More than half (54.5%) of the mothers were nutritionally deprived based on their body mass index (BMI < 18.5).

Only one-fifth of the mothers start breastfeeding immediately after birth but 80% started within an hour of birth. More than 88% of the mothers breastfed their children until two years of age and 25% continued breastfeeding for more than three years. An early introduction of other non breast milk fluids was very common in the study communities. More than 80% of the mothers initiated feeding their children with non

breast milk pre-lacteal foods. The commonly used pre-lacteal foods were butter (46.7%), sugar dissolved in water (15.1%) and plain water (14.5%). Family foods and cereal based porridge were the most common complementary foods.

Of the 321 under five children, 164 (51.1%) were males and 157 (48.9%) were females. The mean age was 31.9 months. The mean HAZ, WAZ and WHZ scores were -1.55 (95% CI: -1.73 to -1.36), -1.58 (95% CI: -1.72 to -1.44) and -0.77 (95% CI: -0.89 to -0.65), respectively (table 1).

Table 1: Demographic and anthropometric measures of children and their mothers (n = 310 – 321).

Variables	**Mean (sd)**
Child age (months)	31.9 (14.5)
Child weight (kg)	11.1 (2.6)
Child height (cm)	84.7 (10.3)
HAZ	-1.55 (1.64)
WAZ	-1.58 (1.26)
WHZ	-0.77 (1.10)
Maternal age (years)	33.2 (8.3)
Maternal weight (kg)	45.8 (5.5)
Maternal height (cm)	156.7 (5.9)
Maternal BMI (kg/m^2)	18.6 (2.0)
Age at first marriage (years)	14.7 (2.7)
Age at first birth (years)	18.2 (2.3)

The cross-sectional prevalence of stunting, underweight and wasting of children was 42.7%, 38.3% and 13.4%, respectively.

Compared with the NCHS/CDC/WHO reference, the distribution of the z scores of these children was shifted to the left. Child malnutrition increased with age. The prevalence of stunting abruptly changed from 0.93 % in children six months or younger, to 10.9% in children between 6 months and 2 years and to 30.8% in children older than two years of age (Figure 1). Underweight increased from 0.93 % in children six months or younger, to 10.9% in children between 6 months and 2 years and to 26.48% in children older than two years of age (Figure 2). Wasting, also increased from 1.25% in children six months or younger, to 5.3% in children between 6 months and 2 years and to 6.85% in children older than two years of age (figure 3).

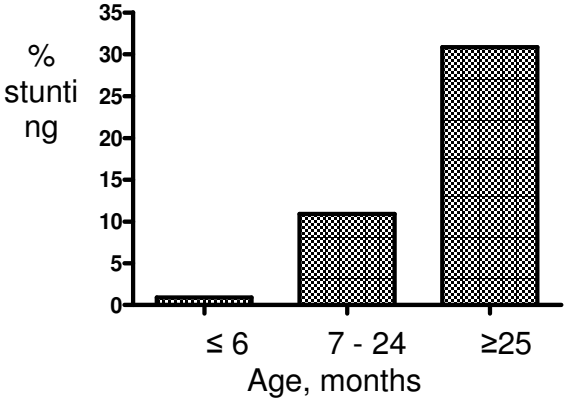

Figure 1: Variation of the level of stunting with age

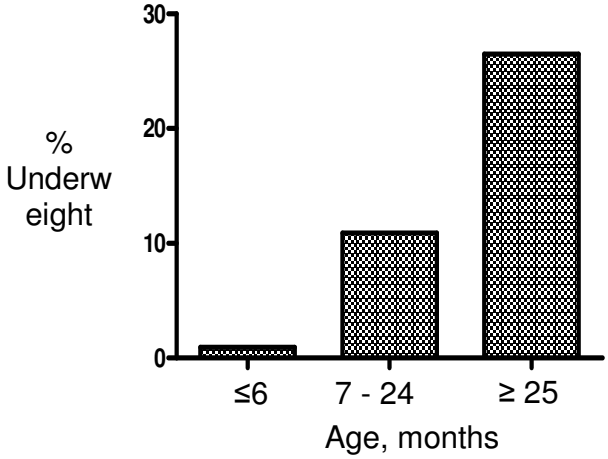

Figure 2: Variation of the level of underweight with age

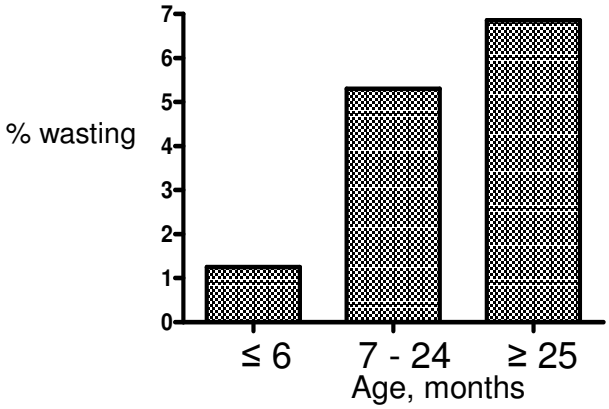

Figure 3: Variation of level of wasting with age

There was no statistically significant difference between the HAZ, WAZ and WHZ scores for male and female children. Like wise there was no significant difference in nutritional status between children from households with and without home gardening.

The level of chronic child malnutrition was worst in the eastern (15.6%) and the central (11.2%) zones as compared to the north western (7.5%) and southern (8.4%) zones. Children from the central zone had significantly lower mean WHZ scores and children from the north western zone had significantly higher mean HAZ scores. The characteristics which significantly affected the child height and weight z-scores are presented in table 2.

Table 2: Effect of age, maternal BMI and complementary foods on child height and weight z-scores.

	HAZ means (se)	WAZ means (se)	WHZ means (se)
Age			
≤ 6 months	0.22(0.43)[a]	0.13(0.32)[a]	-0.23(0.31)
6 – 24 months	-1.11(0.16)[b]	-1.47(0.12)[b]	-0.84(0.11)
> 24 months	-1.86(0.11)[c]	-1.74(0.08)[b]	-0.77(0.08)
p-value	< 0.0001	< 0.0001	0.1875
Maternal BMI			
< 16.5	-0.93(0.24)[a]	-1.46(0.19)	-1.07(0.16)[a]
16.5 – 18.5	-1.71(0.15)[b]	-1.74(0.11)	-0.84(0.10)[ab]
≥ 18.5	-1.60(0.14)[b]	-1.47(0.10)	-0.61(0.09)[b]
p-value	0.0208	0.1697	0.0347
Complementary foods			
No	-2.02(0.16)[a]	-1.84(0.12)[a]	-0.76(0.11)
Yes	-1.32(0.11)[b]	-1.44(0.09)[b]	-0.77(0.08)
p-value	0.0003	0.0089	0.9461
Residence			
Central zone	-1.72(0.21)[a]	-1.95(0.16)[a]	-1.19(0.14)[a]
Eastern zone	-1.53(0.15)[ab]	-1.41(0.12)[b]	-0.54(0.10)[b]
North Western zone	-1.17(0.18)[b]	-1.37(0.14)[b]	-0.82(0.12)[b]
Southern zone	-1.99(0.22)[a]	-1.80(0.17)[ab]	-0.71(0.15)[b]
p-value	0.0289	0.0093	0.0024

**-different letters show significance at p < 0.05and values which share a common superscript are not significantly different from each other at p < 0.05.*

Based on the multiple regression analysis, the best predictors of child height-for-age z-scores were the child age, maternal height and complementary foods and that of child weight-for-age z-scores were the child age, maternal weight and complementary foods. Results of the multiple regression analysis for variables strongly linked to child malnutrition indicators are shown in table 3.

Table 3: Multiple regression analysis of variables linked to child height and weight z-scores (n = 321).

	Estimate	s.e.	p-value
Predictors of height-for-age z-scores (Adj R^2 = 0.1927)			
Intercept	- 11.76477	2.29371	< 0.0001

Child age	- 0.03454	0.00592	< 0.0001
Maternal height	0.06507	0.01452	< 0.0001
Complementary foods	0.67187	0.18214	0.0003
Predictors of weight-for-age z-scores(Adj R^2 = 0.0928)			
Intercept	- 3.11021	0.65902	< 0.0001
Child age	- 0.02167	0.00477	< 0.0001
Maternal weight	0.03316	0.01270	0.0095
Complementary foods	0.42410	0.14691	0.0042

Taller mothers had taller children. Children from families that used cereal-based complementary foods had statistically higher HAZ and WAZ scores than those who did not. Moreover, children from families weaned to family foods had statistically significant higher HAZ scores than those who do not. Child nutritional status become worse with age. Child stunting was worse in the eastern zone followed by the central zone. Children from the central zone had significantly lower mean WHZ scores and children from the northwestern zone have had significantly higher mean HAZ scores than their southern counterparts. Contrary to our expectations, maternal characteristics such as education level and access to family planning services and household characteristics such as access to safe drinking water and latrine were not significantly associated with child malnutrition.

Discussion

In contrast to other studies (9), where boys had significantly worse nutritional status than girls, no association between gender and nutritional status was observed in our study. Complementary foods were the best predictors of child nutritional status in the study communities. Children who received complementary foods from cereals available in the household had a better nutritional status.

Child malnutrition increased with age. It appears that both chronic and acute child malnutrition, develop during the weaning period and rise sharply there after. The retardation of growth which commences in the latter half of the first year, suggests problems associated with child feeding practices and nutrient inadequacy of the complementary foods. Studies have showed that long term breast feeding adversely affects infant appetite and growth (16). Breastfeeding beyond 12 months was very common in these communities and such breast feeding practices might encourage lower acceptance of non breast milk foods and lower energy intake in children. Moreover, the commonly used complementary foods were cereal based prepared by mixing barley, teff, wheat, maize and sorghum flours. These foods are diluted with water to reduce their viscosity and are often unsafe because of unsanitary preparation and storage practices. The total amount of food consumed by young children is affected by feeding frequency, the energy density of the diet, physico-chemical properties of the food, bioavailability of micronutrients and the child's appetite (17-19). More is not necessarily better because of the trade off between intake of complementary foods and intake of breast milk. Though the study did not collect information on the nutrient density of complementary foods, these foods are introduced late and are inadequate in quantity and quality. Promotion of

traditional household technologies such as germination and fermentation may be affordable measures to improve the quality of the complementary foods.

Significant differences in nutritional status were observed amongst the different zones. Eastern zone followed by the central zone have the highest rate of malnutrition. The eastern zone has limited rainfall and the central zone has the highest population density. Such a significant difference in child nutritional status between the zones emphasizes the importance of environmental factors.

Different studies (20) show that maternal education has prominent effects on nutritional status of children. However, in our study, most mothers were illiterates and maternal education was not strongly associated with child nutritional status. The impact of maternal education is not only through its effect on nutrition but also through additional income and the mother's ability to make better decisions for herself and her child. The rural mothers have few opportunities to earn additional income or to make many changes in the child's food intake and hence the lack of significant association between maternal education and child nutritional status should not be a surprise. Similarly, we found no statistically significant association between the nutritional status of children and home gardening by the households. Plausible reasons for such observation include; first, the vegetables in the households might be displacing other staple energy foods. Secondly, the mother's involvement in home gardening might have a negative effect on the children's nutritional status by reducing infants' access to breastfeeding, or might lead to reduction in feeding frequency and to use breastfeeding as a substitute for a regular meal thereby longer duration of breast feeding beyond two years of age. Third, children may be disadvantaged either from being left alone or from exposure to harsh climatic conditions contributing to child weakness and vulnerability to infections. And finally, the vegetables from the home gardening might not be used for household consumption but for income generation, which is not sufficient to compensate for lack of cereal crops.

The results of our study also demonstrate that there was no significant association between access to safe drinking water and child nutritional status. However, there was significant interaction between access to safe drinking water and complementary foods ($p=0.0080$). This might be due to the fact that, many mothers are aware of the general importance of clean water sources but not about what characterizes clean water. Unless, the clean water from the source is utilized and stored under hygienic conditions, it may be contaminated very easily and serve as a vehicle for infections. This situation can further be exacerbated by the absence of latrine facilities in the majority of the households.

Practices of partial breast feeding were to the international and country standards as 88% of the mothers breast fed their children for at least two years. However, one in ten of the children received pre-lacteal feeds immediately after birth. The practice of feeding other liquids/foods early should be discouraged for many reasons including the potential risk of infection and the fact that flow of breast milk is not well stimulated when the infant's hunger and thirst is satisfied by other liquids.

In conclusion, the continued attention to infant breast feeding practices is important to avoid erosion in advantageous traditional breast feeding practices of the rural mothers. The study demonstrates that chronic malnutrition is a public health problem in the study communities. The rate of stunting becomes more apparent as children grow older. The energy and nutrient density of the family and complementary

foods are low as they are prepared from a limited number of local staple cereals and legumes without the addition of sugar, fat or animal products and hence are insufficient to prevent stunting. The results presented here should raise a note of caution for public and local authorities to consistently pursue addressing child malnutrition until substantial results are achieved. As the complementary foods were the main predictors of child nutritional status in the study communities, sustained nutrition education programs to mothers focusing on appropriate child feeding practices are recommended.

Acknowledgment

The study was supported by the Netherlands Development Cooperation through the Poverty Reduction and Environmental Management (PREM), Institute of Environmental Studies (IVM), Vrije Universiteit, Amsterdam, the Netherlands and Mekelle University, Ethiopia. We thank the local administrators and community leaders for their support during the survey.

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