Initial results of

Sunyani Municipal Nutrition Survey 2010

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1. Foreword

This report is a presentation of the initial results of Sunyani Municipal Nutrition Survey carried out from March to May 2010. Additional analysis of the material will be performed as a part of the masters thesis, which will be finished by March 1st 2011. A copy of the thesis will be send to the Municipal Health Directorate.

2. Abstract

Background: Undernutrition (wasting, stunting and underweight) is a major problem in most developing countries. It causes increased morbidity and mortality in childhood, restricted development, reduced cognitive abilities and increased risk of complications during pregnancy and labour. The extend of nutritional problems in Sunyani Municipality is unknown and for health workers to be able to target prevention efforts there is a need to detect risk factors and identify possible strategies to improve the nutritional status among children <5 years.

Methods: Sunyani Municipal Nutrition Survey took place in March, April and May 2010, combining a questionnaire survey among mothers with children <5 years, and qualitative interviews with health workers and mothers.

Subjects: The questionnaire survey included a total of 357 children below 5 years and their 281 mothers sampled through random cluster sampling from the whole of Sunyani Municipality. The qualitative part included five health workers and eight mothers purposefully sampled from the municipality.

Results: The results show a prevalence of underweight (WAZ <-2SD) at 10.6 %, of wasting (WHZ <-2SD) at 10.0 %, and stunting (HAZ <-2SD) at 11.1 %. The total prevalence of any nutritional problem is 20.9 %. Another 36.3 % of the children are at risk of developing nutritional problems (having z-scores from -1SD to -2SD). Eight risk factors were identified: 1. Poor maternal nutrition. 2. Low socioeconomic status. 3. Mothers, who are not married. 4. Low level of maternal education. 5. Young mothers. 6. Children, who have been sick. 7. Children with low birth weight. 8. Transition to complementary feeding and weaning.

Suggested actions: Based on the findings the following actions are suggested: Health workers should pay increased attention to vulnerable mothers, sick children and children with low birth weight. There should be focus on improving complementary feeding patterns. A nutrition seminar for health workers in the sub-municipality should be conducted to better equip health workers to prevent nutritional problems.

3. Introduction to Sunyani Municipal Nutrition Survey

In the following the objectives of the survey, the qualitative and quantitative methods used and the ethical aspects will be described.

3.1. Objectives

The main objective of the nutrition survey was the following:

> *To assess the nutritional status of children <5 years in Sunyani Municipality, find out which factors contribute to increased risk of undernutrition and offer recommendations on how to improve the nutritional status in the municipality.*

While the following specific objectives were chosen:

a. *To assess the nutritional status in the municipality according to the WHO standards (z-scores: height-for-age, weight-for-height, weight-for-age and mid-upper-arm-circumference-for-age)*
b. *To find out how the socioeconomic status of the household influences nutritional status.*
c. *To find out how the educational level of parents influence nutritional status.*
d. *To find out how the child's food variety and dietary diversity influence nutritional status.*
e. *To find out, if it is possible to define a group of children at risk of undernutrition and what characterizes this group.*
f. *To offer recommendations on how to improve the nutritional status in the municipality.*

This report will seek to answer objective a. in details, give initial answers to objectives b., c. and d., and briefly touch on objective e. and f.

3.2. Methods

To assess the above-mentioned objectives it was decided to use a combination of quantitative and qualitative methods.

Quantitatively a questionnaire was developed, consisting of 4 parts:

1. A mother/caretaker questionnaire with questions on the household, parents' educational level, socioeconomic status and health knowledge of the mother.
2. A child questionnaire with questions on age, siblings, immunizations, illness and feeding of the child.

3. A food questionnaire, consisting of a list of 97 different food items, which was only filled for complementary fed children.
4. An anthropometry part, including the following measurements: Children's weight, length/height (recumbent length <2 years and height >2 years) and mid-upper-arm-circumference (MUAC) and mothers' weight and height.

The questionnaire was developed using relevant scientific literature and in corporation with Nutritional Officer Mr. Thomas Cudjoe. Members of the district health management team gave feedback during a pre-test and a pilot study was carried out with participants from different parts of Sunyani Municipality.

The questionnaire survey took place from March 17th to April 14th 2010. A team of four Twi-speaking interviewers, together with the researcher, visited a total of 41 randomly selected cluster sites in the whole of Sunyani Municipality. Data was entered twice using Epidata[1], z-scores were calculated with the software WHO Antro[2] and all statistical analysis carried out in SPSS[3].

The qualitative part of the survey consist of a total of 13 in-depth interviews, five with health workers and eight with mothers, both from different parts of the municipality. The health workers were interviewed in English and the mothers in Twi with the use of a translator. The interviews were carried out in the period May 7th-18th 2010. All interviews were fully transcribed.

3.3. Ethics

Ethical clearance was obtained from the Regional Health Directorate. Informed oral consent was obtained from all participants. All material is handled confidentially and in an anonymized form.

4. Description of the survey population

A total of 357 children with 281 mothers/caretakers were included in the survey. The distribution on the different submunicipalities is shown in table 1.
The 41 clusters were classified as either rural (11 clusters) or urban (30 cluster).
Below is given characteristics of the children, the mothers and the households.

[1] Lauritsen JM & Bruus M. EpiData (version 3.1). *A comprehensive tool for validated entry and documentation of data*. The EpiData Association, Odense Denmark, 2004 (free download).
[2] WHO Anthro Software, World Health Organization, Geneva, from www.who.int/childgrowth/software/en (free download)
[3] PASW Statistics 18.0

Table 1: Distribution of children on submunicipalities

Submunicipality	% of the children
New Town/Baakoniaba	23.0 %
Antwikrom	17.6 %
New Dormaa	15.7 %
Abesim	15.1 %
Sunyani Central	14.3 %
Penkwase/Regional Hospital	14.3 %

4.1. Characteristics of the 357 children

The 357 children were divided on 183 girls (51.3 %) and 174 boys (48.7 %). The age distribution of the children is displayed in table 2, which shows that the number of children decreases in the higher age groups. This is probably because the younger children are more often together with their mothers and thus more likely to be included in the survey. Mothers of older children are more likely to leave the house to go to the farm or work, and older children are more likely to be in school – even though the data collection took place on Saturdays and in afternoons when most children had returned from school.

Table 2: The age-distribution of the children.

Age	% of the children (#)
0-11 months	24.6 % (87)
12-23 months	24.1 % (85)
24-35 months	20.7 % (73)
36-47 months	17.8 % (63)
48-59 months	12.7 % (45)
Total 0-59 months	*100 % (353)**

**4 children were above 5 years (60, 61, 66 and 71 months respectively)*

The mean number of siblings was 1.21 (Std.D. 1.19, range 0-6). Most of the children (42.1 %) had 1 sibling, 29.2 % had none and 15.7 % had 2. These numbers include twin siblings; a total of 21 children (5.9 %) were twins.

4.1.1 The health of the children

Health records were available for 80.3 % of the children and from these information was obtained on birth weight, birth date, vitamin A supplementation and immunizations. Birth weight was available for 66.9 % (239) of the children with a mean of 3.05 kg. (std.D. 0.50, range 1.15-4.70). Vitamin A coverage was almost complete, as 97.2 % of the children with health records had received at least 1 dose. Immunization status was calculated depending on the age of the child. Data was available for 290 children of whom 93.8 % were fully immunized.

The mothers were asked if the child had had any illnesses the last 2 weeks. This was the case for 25.4 % (90) of the children. Table 3 shows which illnesses the children had. Fever is the most prevalent disease followed by diarrhoea.

Table 3: The prevalence of different illnesses in the children

Illness	# of children*	% of children with any illness*	% of all children
Fever	50	55.6 %	14.01 %
Diarrhoea	22	24.4 %	6.16 %
Cough	14	15.6 %	3.92 %
Malaria	11	12.2 %	3.08 %
Other illness	5	5.6 %	1.40 %

**Total exceeds more than 90 and more than 100 % as some children had more than one illness*

Of the 90 children, who had been sick 76.4 % were taken to a health facility and 88.8 % were given medicine, which was either prescribed from the health facility (83.8 %) or bought without prescription (15.0 %). Three children were taken to a traditional healer and one child was given traditional medicine.

4.1.2 Feeding of the children

The mothers were asked about several aspects of the feeding patterns of their children: If the child was still breastfed, if the child had ever received water and complementary food and at which age, when the child was weaned and the number of breastfeedings and meals/snack in a day.

Most of the children (93.3 %) had received water, with a mean age of introduction of 5.09 months (table 4). Almost 10 % of the children were given water at birth. Complementary feeding had been introduced to 90.8 % of the children at a mean age 6.02 months (table 5).

Table 4: Introduction of water to the children

Water		% of the children (#)	Mean age of introduction
Child ever given water (yes)		93.3 % (333)	5.09 months
Age of introducing water	0 months	9.1 % (30)	
	1-5 months	16.4 % (54)	
	6 months	71.1 % (234)	
	> 6 months	3.3 % (11)	

It is remarkable that 71.1 % of the mothers said they introduced water at exactly 6 months and 67.4 % introduced complementary foods at exactly 6 months. This either shows that the mothers practice exclusive breastfeeding or is a sign of social desirability bias (the mother answers, what she thinks is the right answer).

Table 5: Introduction of complementary feeding

Complementary feeding		% of the children (#)	Mean age of introduction
Child receiving complementary food (yes)		90.8 % (324)	6.02 months
Age of introducing complementary foods	<6 mo	13.5 % (43)	
	6 mo	67.4 % (215)	
	>6 mo	19.1 % (61)	

Just above half (58.0 %) of the children were weaned with a mean age of 19.39 months. One third (31.2 %) of the children were weaned before 18 months and at 18 months almost half of the children (48 %) had been weaned.

Table 6 and 7 show the frequencies of breastfeedings and meals in a day. Most of the breastfed children were breastfed 7-10 times a day and most of the children receiving complementary food ate 3-4 meals and snacks in a day.

Table 6: Number of meals/snacks in a day.

# of meals/day	% of the children (#)
0 = not complementary fed	9.2 %(33)
1-2	3.1 % (11)
3-4	77.9 % (278)
5-6	4.5 % (16)
>7	0 %
Don't know	5.3 % (19)

Table 7: Number of breastfeedings in a day

# of breastfeeding/day	% of the children (#)
0 = weaned	56.9 % (198)
1-3	0.9 % (3)
4-7	10.3 % (36)
7-10	17.8 % (62)
>10	10.9 % (38)
Don't know	3.2 % (11)

As mentioned the food questionnaire asked about whether the child had eaten 97 different food items. Table 8 shows the percentage of children, who ate the individual food items the last week.

The food items were divided into 14 food groups, which are listed in table 9 together with the number of foods in the group and the percentage of children, being complementary fed, who ate any of the foods in the group. As can be seen almost all children ate food from most of the groups. Grains and cereals, sugar and fruits are the most frequently eaten, while dairy products and milk (including breast milk) were less frequently eaten.

Table 8: Percentage of the children who ate the different food items during the last week.

Food item	%
Maize	97.5
Rice	92.6
Onion	89.5
Tomato	89.4
Salt	87.3
Pepper (chili)	87.0
Palm oil (red)	86.1
Sugar	85.4
Garden eggs	83.9
Orange	83.9
Okra	83.0
Banana	81.8
Plantain	81.5
Kontomire	81.4
Eggs	80.9
Groundnuts	80.9
Bread	79.2
Yams	79.2
Cocoyam	78.4
Cassava	74.3
Palm nuts	71.9
Pineapple	71.8
Sorghum	70.0
Milo	69.6
Cake/pastry w. sugar	66.5
Chicken	65.9
Tilapia	64.6
Soft drinks	63.8
Tea	61.9
Millet	61.7
Herring	61.4
Wheat flour	61.3
White beans	59.1
Salmon	57.1
Pawpaw	56.2
Mushroom	53.6
Vegetable oil	53.3
Cake/pastry w. fat/oil	53.1
Mango	51.9
Cow/beef	50.8
Spaghetti	48.0
Red beans	45.3
Dawadawa	44.1
Avocado	42.4
Sweets/candies	41.9
Cabbage	41.8
Soya beans	40.6
Tinned/condensed milk	39.3
Mudfish	39.2
Sweet pepper	37.9
Fruit juice	37.3
Carrot	36.2
Coconut	35.8
Breast milk	34.9
Salad leaves	34.4
Cucumber	33.5
Agushie	31.5
Palm kernel oil	31.1
White potatoes	29.5
Any fried food	29.4
Tom Brown	29.1
Apple	27.9
Chocolate	27.3
Ayoyo	27.0
Butter/margarine	26.1
Honey	24.8
Bambara beans	24.5
Sweet potatoes	24.5
Cowpeas	23.6
Aleefu	22.0
Watermelon	20.1
Sheep/mutton	18.6
Sugar cane	18.3
Goat/chevron	17.0
Ice-cream	16.7
Oat porridge	15.8
Yogurt	15.7
Guava	15.6
Corn flakes	14.6
Cooking fat	13.9
Green beans	13.3
Fish powder	13.0
Jam	11.8
Shea butter	11.4
Bean leaves	7.1
Infant formula	6.8
Cows milk	6.5
Baobab tree leaves	6.3
Cheese	6.2
Pig/pork	5.0
Cassava leaves	4.4
Bokoboko	3.7
Lentils	2.2
Any other fish	1.5
Any other meat	1.3
Any other food eaten	0.6
Other vegetables/fruits	0.0
Other beans	0.0

Table 9: Percentage of children, who ate any food from the 14 food groups

Food group	# of foods	%
Grains & cereals	10	98.8
Sugar	9	94.8
Fruits & juices	12	93.2
Vegetables	10	92.6
Fish	6	91.7
Oil & fats	8	89.5
Other	3	88.9
Nuts, pulses & legumes	12	87.7
Roots & tubers	6	85.5
Green leaves	7	84.9
Egg	1	80.9
Meat	6	73.8
Milk	4	56.5
Dairy products	3	24.4

Two measures were combined from the food questionnaire: The food variety score (FVS) and the dietary diversity (DD). The food variety score simply sums the number of food items the child has eaten during the last week, while the dietary diversity counts from how many of the 14 different food groups the child ate any food during the last week. The two measures are only computed for the part of the children, who received complementary feeding.

The distribution of the two measures is shown in table 10. As can be seen the mean FVS was 42 points out of the 97 possible. From the histogram (figure 1) it is clear that most children ate a quite large number of different foods. The dietary diversity is equally high with a mean of 11 points out of the 14 possible. As displayed in the histogram (figure 2) most children ate food from 12-13 different food groups, but there are as well children only eating food from 2 different groups.

Table 10: Distribution measures of FVS and DD

	Maximum point	Mean	Std.D.	Min.	Max.
Food Variety Score	97	41.68	15.60	2	85
Dietary Diversity	14	11.43	2.66	1	14

Figure 2: Distribution of the FVS-score

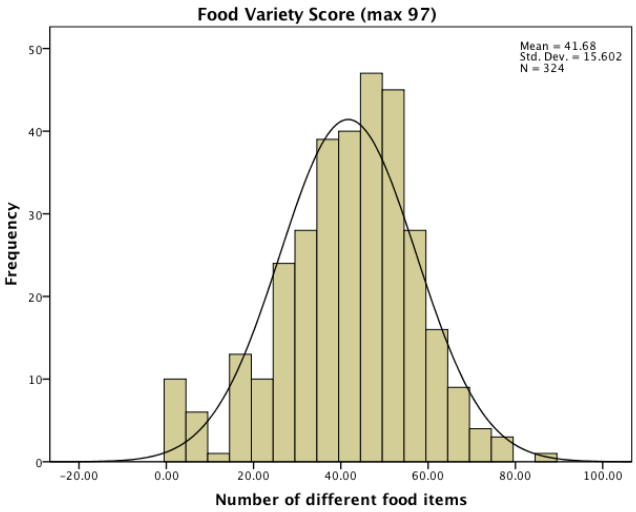
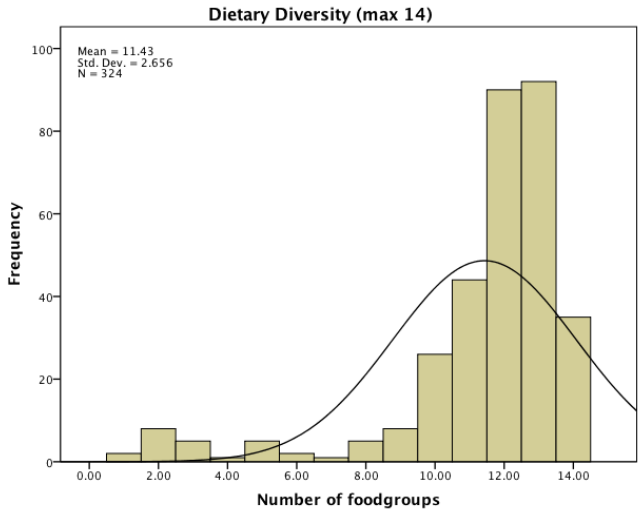


Figure 1: Distribution of the DD-score



4.2. Characteristics of the 281 mothers

Almost all the mothers/caretakers included in the survey were mothers of the child (97 %), while 2.1 % (6) were caretakers and 0.7 % (2) 'other' (one father and a mother, who was a caretaker of another child included). The mean age of the mothers was 29 years ranging from 17-48 years.

As can be seen in table 11 most of the mothers (95 %) were married and 80 % of them stayed together with the husband. In addition 27 % lived with their mother in the household. The number of children below 5 years was mainly one (73 %) while 24 % had two and 2 % three.

Table 11: Characteristics of the 281 mothers and caretakers in the survey.

		% of mothers (#)
Marital status	Married	94.6 % (265)
	Cohabiting	1.4 % (4)
	Never married	3.2 % (9)
	Widow	0.7 % (2)
	Separated, divorced, other	0
Children below 5 years	1	73.3 % (206)
	2	23.5 % (66)
	3	1.8 % (5)
Husband staying in household (yes)		79.6 % (222)
Grandmother staying in household (yes)		26.5 % (74)

The mothers in the survey were weighed and their height measured. From these two measures their BMI was calculated. The distribution of the three measures is shown in table 12 and in figure 3-5.

Table 12: Distribution of the weight, height and BMI of the mothers.

	Mean	Std.D.	Range
Weight*	63.88 kg	11.96	41.8-97.8 kg
Height	159.29 cm	5.74	145.6-173.9 cm
BMI	25.12	4.42	17.31-39.64

**Thirteen mothers (4.8 %) knew they were pregnant at the time of measuring.*

Figure 3: The distribution of the maternal weight.

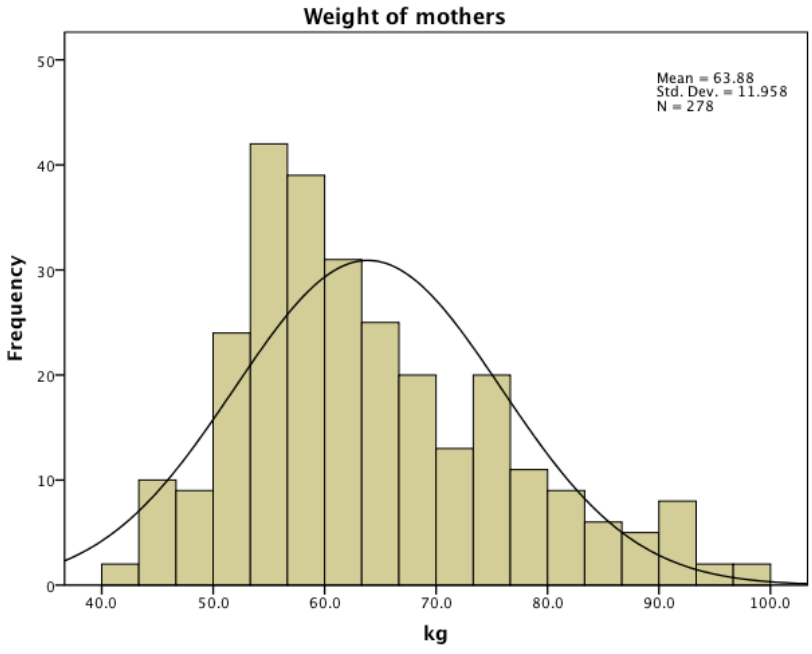


Figure 4: Distribution of the maternal height.

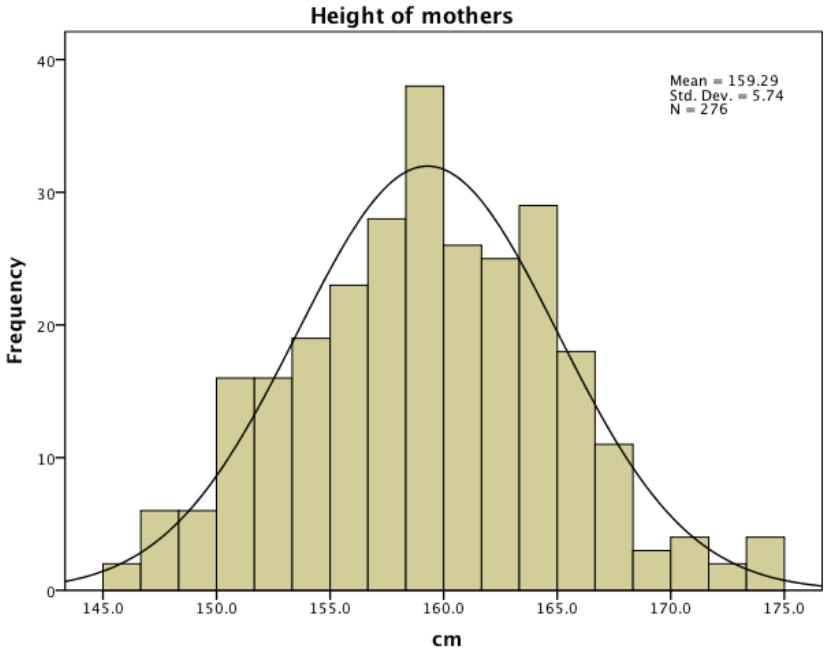
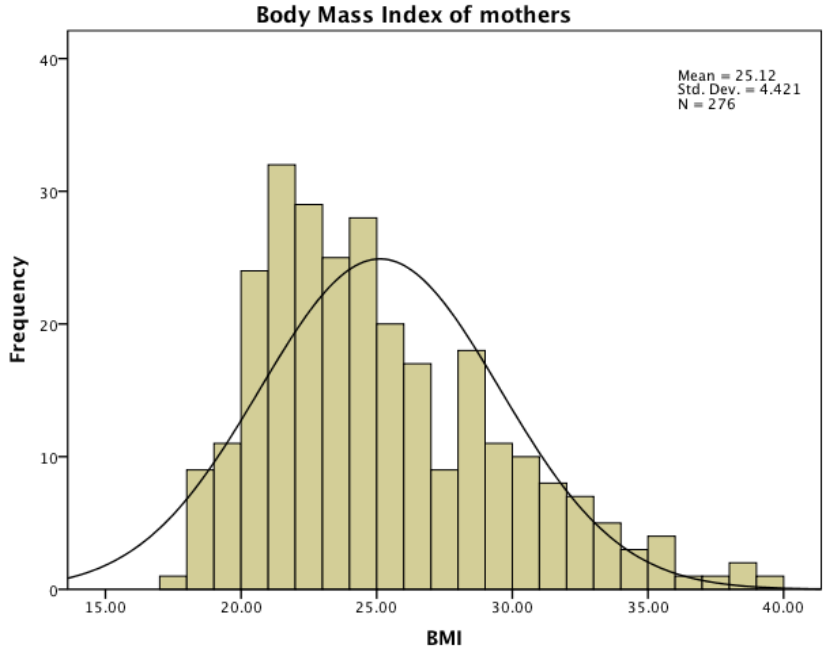


Figure 5: Distribution of the maternal BMI



As seen above most of the mothers (exactly 50 %) have a BMI of 20-25, which is considered normal weight. Very few (7.6 %) are underweight (BMI<20), while quite a number (27.2 %) are overweight (BMI>25) and 15.2 % obese (BMI>30).

The mothers were asked three questions on health knowledge: Which foods are rich in vitamin A? How can you prevent malaria? And: What can you do in case your child has diarrhoea? A total health knowledge score was computed by simply summing the number of correct answers from the three questions. The mean score was 5.10 (Std.D. 1.996, range 0-11). Most of the mothers had 3, 4 or 5 points.

4.3. Characteristics of the 281 households

The 281 households had a mean size of 5.41 members (Std.D. 2.31, range 2-19). Four members was the most prevalent size (28.5 % of the households), followed by 5 members in 19.5 % of the households, 3 members in 15.0 %, 6 members in 10.5 % and 7 members in 10.5 %.

The households generally had more children than adults. The mean number of children <18 years was 2.74 (Std.D. 1.68, range 1-14), while the mean number of adults was 2.61 (Std.D. 1.36, range 1-11).

Mothers were asked about their occupation and the occupation of their husbands. The distribution of the two is shown in table 13.

Table 13: Occupation of the parents

Occupation	Mother (%)	Father (%)
Housewife/unemployed	11.4 %	1.1 %
Farmer, own land	15.0 %	14.6 %
Farmer, others land	2.5 %	2.9 %
Petty trading/small business	41.4 %	18.2 %
Governmental employed	5.4 %	21.8 %
Artisan	13.9 %	19.3 %
Other	10.4 %	21.1 %
Unknown	-	1.1 %

Information was obtained on the educational levels of the mother, the father and the grandmother (table 14). It is clear that the fathers are the ones having the highest educational level, while the grandmothers have the lowest.

Table 14: Educational levels of mothers, fathers and grandmothers

Educational level	Yrs in total	Mother (%)	Father (%)	Grandmother (%)
None	0	18.2	14.0	66.1
Primary School	6	10.4	1.5	11.7
JHS	9	53.6	43.9	16.4
SHS/Vocational training	12	16.1	25.0	4.4
Tertiary (college,polytechnical,university)	>12	1.8	15.5	1.5

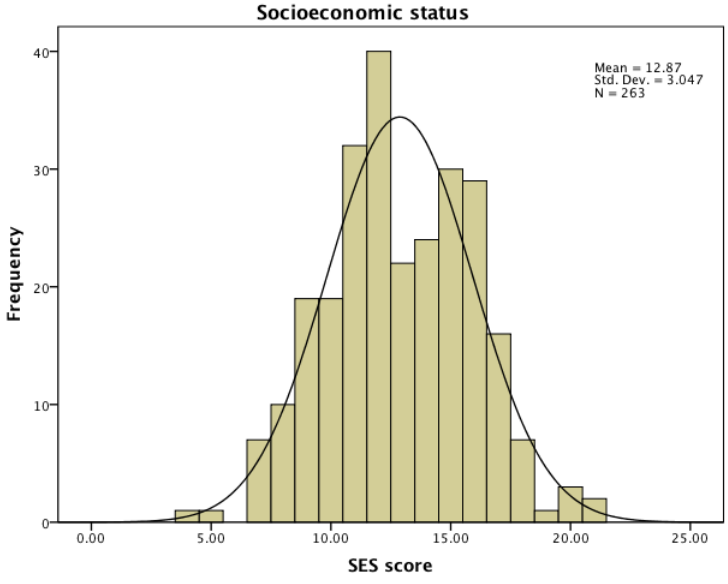
A number of questions were asked on different socioeconomic conditions. The frequencies of the variables are shown in table 15. Answers were given points as shown in the table and the variables were summed to a total measure of the socioeconomic status of the household on a scale with a range of 0-23 points.

Table 15: Frequencies of socioeconomic variables.

Variable	Categories (points on SES-scale)	% of households (#)
House ownership	Rented/Other/Don't know (0)	47.5 % (133)
	Owned (1)	52.5 % (147)
Walls material	Clay/wood/other (0)	10.0 % (28)
	Bricks/cement blocks (1)	90.0 % (252)
Roofing material	Thatched/leaves/other (0)	2.1 % (6)
	Iron sheets/concrete (1)	97.9 %(274)
Flooring material	Clay/other (0)	2.9 % (8)
	Tiles/cement/concrete (1)	97.1 % (272)
Latrine	'Free range'/Other (0)	0
	Public/communal (1)	58.2 % (163)
	In house/outside house (2)	41.8 % (117)
Water Source	River/pond/other (0)	0
	Community well/borehole/community tap (1)	56.8 % (159)
	Tap/well outside house (2)	14.6 % (41)
	Tap/well inside house (3)	28.6 % (80)
Cooking fuel	Firewood/other (0)	34.6 % (97)
	Charcoal/kerosene (1)	46.9 % (131)
	Gas/electricity (2)	18.6 % (52)
Assets	Radio (yes = 1 point)	95.7 % (265)
	Mobile phone (yes = 1 point)	88.5 % (246)
	TV (yes = 1 point)	68.6 % (190)
	Refrigerator (yes = 1 point)	40.1 % (111)
	Poultry (yes = 1 point)	33.9 % (94)
	Bike (yes = 1 point)	24.5 % (68)
	Goats/sheep (yes = 1 point)	23.6 % (65)
	Car (yes = 1 point)	13.7 % (38)
	Motorbike (yes = 1 point)	12.2 % (34)
	Computer (yes = 1 point)	9.4 % (26)
Ownership of agricultural land (yes = 1 point)		63.0 % (174)
Electricity (yes = 1 point)		75.6 % (275)

A valid SES-score was available for 216 households (93.5 %) with a mean score of 12.86 (Std.D. 3.05, range 4-21). The measure was tested for correlations with the interviewer-evaluated SES (on a scale from 1-10), maternal and paternal occupation and maternal, paternal and grandmother education. The scale was positively correlated with all these measures. The distribution the socioeconomic score is displayed in figure 6.

Figure 6: Distribution of the SES-score of the housholds.



5. Frequencies of nutritional problems

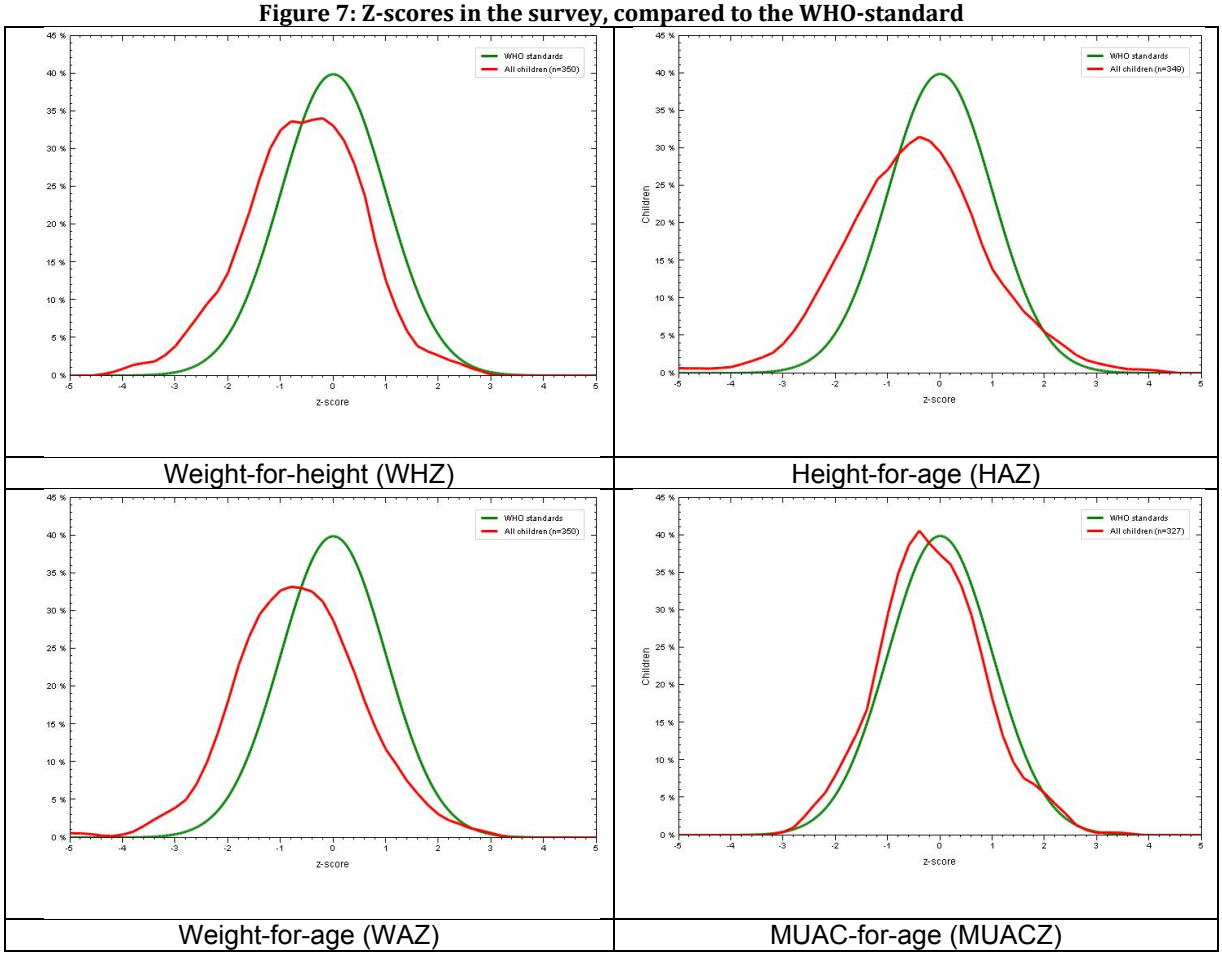
Children aged <2 years had recumbent length measured (46.6 % of the children), while children >2 years had standing height measured (53.4 % of the children). Most children <3 years were weighed hanging with a Salter scale (a total of 55.3 % of the children), the rest were weighed standing on a bathroom scale.

Using WHO Anthro z-scores were calculated for all children. The distribution is shown in table 16 and figure 7. The red lines in figure 7 show the z-scores of the children in the survey while the green lines are the WHO-standard. As can be seen the curves are all below standard, which is confirmed by the fact that the mean z-scores are all negative.

Table 16: Description of the z-scores of the children

Z-scores	Mean	Std.D.	Range (Min and Max)	
Weight-for-age (WAZ)	-0.6568	1.1732	-4.99	2.63
Height-for-age (HAZ)	-0.4922	1.3775	-6.03	3.71
Weight-for-height (WHZ)	-0.5711	1.1039	-3.87	2.52
MUAC-for-age (MUACZ)	-0.1607	0.9903	-2.74	3.24
BMI-for-age (BAZ)	-0.4999	1.1283	-3.94	2.43

Figure 7: Z-scores in the survey, compared to the WHO-standard



Weight-for-height (WHZ) | Height-for-age (HAZ)

Weight-for-age (WAZ) | MUAC-for-age (MUACZ)

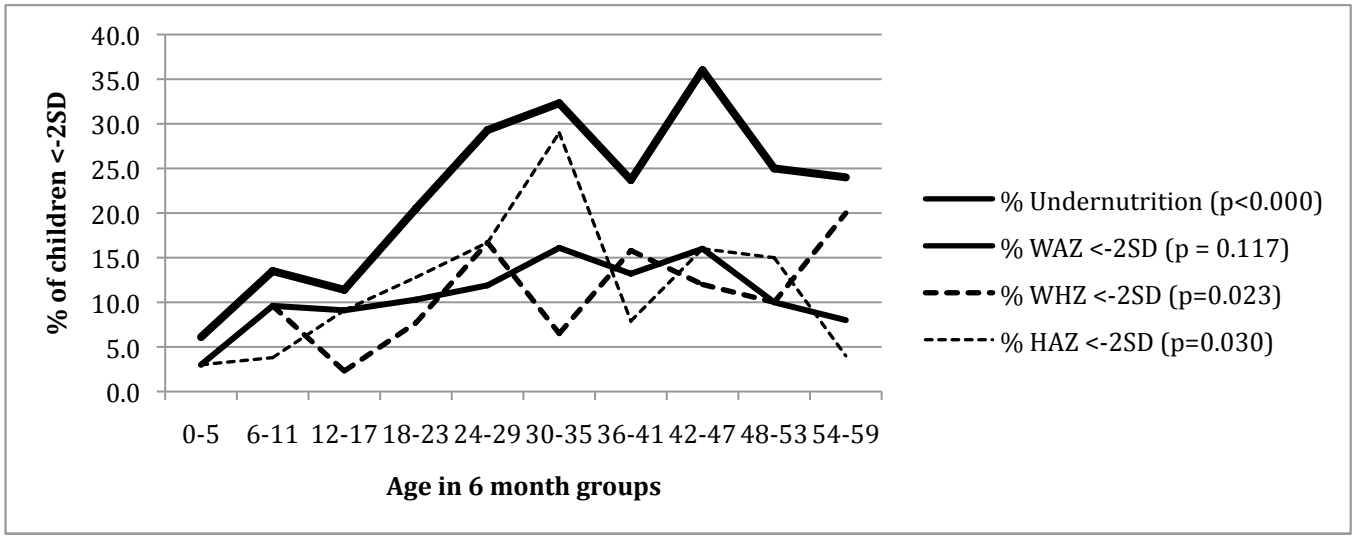
The frequencies of underweight, wasting, stunting and low MUAC were calculated as the number of children having a z-score below -2SD (table 17). In addition a total undernutrition frequency was calculated as the percentage of children having any of the four nutritional problems. Underweight was present in 10.6 % of the children, wasting in 10.0 %, stunting in 11.1 %, and low MUAC in 3.7 %. In total 20.9 % of the children have any nutritional problem.

Table 17: Prevalence of undernutrition

Category	% (#)
Underweight (WAZ <-2SD)	10.6 % (37)
Wasted (WHZ <-2SD)	10.0 % (35)
Stunted (HAZ <-2SD)	11.1 % (39)
Low MUAC (MUACZ <-2SD)	3.7 % (12)
Undernourished (WAZ/WHZ/HAZ/MUACZ<-2SD)	20.9 % (73)

In figure 8 it can be seen that the percentage of children with the different nutritional problems generally increases with increasing age.

Figure 8: Percentage of undernourished children in 6 month age groups



The children were divided into groups of normal nutritional status (> -1SD), at risk (-1 to -2SD), having a problem (-2 to -3SD) and having a severe problem (< -3SD). Table 18 shows that another 21.2-28.3 % are at risk of getting problems of undernutrition and 1.7-3.4 % of the children are having severe problems.

Table 18: Percentage of children at risk, having problems and having severe problems

	Normal (>-1SD) % (#)	Risk (-1to-2SD) % (#)	Problem (-2to-3SD) % (#)	Severe(<-3SD) % (#)
WAZ	61.1 (214)	28.3 (99)	7.7 (27)	2.9 (10)
WHZ	66.6 (233)	23.4 (82)	8.3 (29)	1.7 (6)
HAZ	67.4 (236)	21.4 (75)	7.7 (27)	3.4 (12)
MUACZ	82.6 (270)	13.8 (45)	3.7 (12)	0 (0)

6. Factors associated with undernutrition

This of the paper will solely look at the binary variables of underweight, wasting, stunting and undernutrition. First associations with other factors in the survey are assessed with the use of crosstabs and chi-square or gamma-tests for categorical variables and logistic regression for continuous variables. Then a logistic regression analysis is performed included the factors, which are found to be significantly related.

6.1. Associations between risk factors and nutrition

The following factors were tested for associations with underweight, wasting, stunting and undernutrition:

- Household variables (14): Age of mother, marital status, husband in household, grandmother in household, # children below 5, household size, maternal occupation, paternal occupation, maternal education in 5 groups, paternal education in 5 groups, grandmother education in 5 groups, total SES-score, interviewer SES and health knowledge.
- Child variables (18): Sex, age in months, age in 6 months groups, age in 1 year groups, # of siblings, twin, birth weight, vitamin A, immunization status, illness during the last two weeks, breastfeeding, age of weaning, water, age of water, complementary feeding, age of complementary feeding, number of meals, number of breastfeedings, food variety score (FVS) and dietary diversity (DD).
- Maternal anthropometry variables (3): Weight, height and BMI (time of measurement was included together with weight and BMI as it was found that weight and BMI of the mother increased with the time of measurement).
- General variables (3): Interviewer, submunicipality, rural/urban cluster.

6.1.1 Underweight (WAZ < -2SD)

Below is a description of the variables found to be significantly (chi-square or gamma $p<0.05$) related to underweight in the children.

- *Maternal education in 5 groups* (gamma p=0.033): The more education the mother has, the lower is the prevalence of undernutrition in the child.
- *SES-score* (wald-test p=0.003): For every additional point on the 23 point SES-scale the child has 17 % less risk of underweight.

- *Interviewer SES* (wald-test p=0.040): For every additional point on the 10 point evaluation scale the child has 21 % less risk of underweight.
- *Vitamin A* (gamma p=0.008): The children, who have received vitamin A supplements are more often underweight, which could probably be explained by the increasing age of the child.
- *Illness* (chi-square p=0.002, gamma p=0.010): The children, who have been sick the last 2 weeks have significantly higher risk of being underweight.
- *Water* (gamma p<0.000): Children receiving water have a higher risk of being underweight, which might again be affected by the age of the child.
- *Complementary feeding* (chi-square p=0.045, gamma p<0.000): Children who are being complementary fed have a higher risk of being underweight.
- *Number of meals a day* (gamma p=0.08): Children receiving more meals in a day have higher risk of underweight. This might though be related to age.
- *Maternal weight* (wald-test p<0.000): Each additional kg the mother weighs reduces the child's risk of underweight by 5 %.
- *Maternal BMI* (wald-test p=0.024): For every additional BMI-point of the mother the child has 11 % less risk of underweight.
- *Interviewer* (gamma p=0.013): A slight difference in the prevalence of underweight between the interviewers ranging from 5.5 % to 16.0 %.

6.1.2 Wasting (WHZ < -2SD)

Below is a description of the variables found to be significantly (chi-square or gamma p<0.05) related to wasting in the children.

- *Age in months* (wald-test p=0.030): For each additional month the child is older the risk of wasting increases by 2.5 %.
- *Age in 1-year groups* (gamma p=0.31) and *age in 6-month groups* (gamma p=0.23): The older the child is, the higher is the risk of wasting.
- *Vitamin A* (gamma p=0.010): Children having received vitamin A have higher risk of wasting. This might be a result of the age difference described above.
- *Breastfeeding* (chi-square p=0.040, gamma p=0.029): The children, who are no longer breastfed have higher risk of wasting than the children, who are still breastfed.
- *Water* (gamma p<0.000): Children who have been given water have higher risk of being wasted.

- *Complementary feeding* (gamma p<0.000): Children who are complementary fed have higher risk of being wasted.
- *Number of meals* (gamma p=0.004): Like for underweight more meals increase the risk of being wasted, which might be affected by the age of the child and the few number of children received other than 3-4 meals.
- *Maternal weight* (wald-test p=0.034): Each additional kg the mother weighs reduced the child's risk of wasting by 4 %.
- *Maternal BMI* (wald-test p=0.019): Each additional point of the mothers BMI reduces the child's risk of wasting by 11 %.

6.1.3 Stunting (HAZ < -2SD)

Below is a description of the variables found to be significantly (chi-square or gamma p<0.05) related to stunting in the children.

- *Age of mother* (wald-test p=0.051): For each additional year the mother is older the child has 6 % less risk of stunting.
- *Marital status* (chi-square p=0.002): Children of mothers who are cohabiting or never married are at significantly higher risk of stunting.
- *Maternal education in 5 groups* (chi-square p=0.035, gamma p=0.001): The more years of maternal education the less is the risk of stunting in the child.
- *Age in 1-year groups* (chi-square p=0.008) and *Age in 6-month groups* (chi-square p=0.024, gamma p=0.030): During the first 3 years (<36 mo) the risk of stunting increases drastically, from 3-5 years the risk is reduced.
- *Vitamin A* (gamma p=0.008): Stunting is more prevalent among children who have received vitamin A – again age might be a confounder to this association
- *Complementary feeding* (gamma p=0.026): Stunting is more prevalent among complementary fed children. But this might be due to a hidden age effect.
- *Dietary Diversity* (wald-test p=0.054): Each additional food group increases the risk of stunting by 12 % – again this might be a hidden age effect as older children are more likely to eat food from more different groups.
- *Maternal weight* (wald-test p=0.001): The risk of stunting falls by 6.3 % for each additional kg in the mother's weight.
- *Maternal BMI* (wald-test p=0.003): Each additional BMI-point reduced the risk of stunting by 14 %.

6.1.4 Undernutrition (WAZ/WHZ/HAZ/MUACZ < -2SD)

Below is a description of the variables found to be significantly (chi-square or gamma p<0.05) related to any undernutrition problem in the children.

- *Marital status* (chi-square p=0.049): Children of mothers who are cohabiting or never married have significantly higher risk of undernutrition than children of married mothers.
- *Maternal education in 5 groups* (chi-square p=0.047, gamma p=0.004): The more years of maternal education, the less is the risk of undernutrition.
- *Age in months* (wald-test p=0.003): Each additional month of the child's age increases risk of undernutrition by 2.4 %.
- *Age in 1-year groups* (chi-square p=0.009, gamma p=0.001) and *Age in 6-month groups* (gamma p<0.000): Older children have higher risk of undernutrition.
- *Birth weight* (wald-test p=0.058): Each additional kg of birth weight reduced the risk of undernutrition by 47 %.
- *Vitamin A* (gamma p=0.005): Children who have received vitamin A have higher risk of being undernourished – this might be a hidded age-effect.
- *Illness* (chi-square p=0.009, gamma p=0.017): Children who have been sick the last two weeks have significantly higher risk of being undernourished. It is important to keep in mind that the causal direction cannot be told. It is thus impossible to say whether illness increases the risk of undernutrition or undernutrition increases the risk of illness.
- *Breastfeeding* (chi-square p=0.004, gamma p=0.003): Children, who are still breastfed have significantly lower risk of being undernourished.
- *Water* (gamma p=0.004): Children receiving water are more often undernourished.
- *Complementary feeding* (chi-square p=0.011, gamma p<0.000): Complementary fed children have a higher prevalence of undernutrition.
- *Number of meals* (chi-square p=0.032, gamma p=0.001): Children receiving 3-4 or 5-6 meals a day have higher risk of undernutrition than children receiving 0 or 1-2, but this might be an age effect.
- *Number of breastfeedings* (gamma p=0.034): The tendency is not clear, but it seems children not receiving any breastfeedings (weaned) and children being breastfed more than 10 times a day have higher risk of undernutrition.

- *Dietary Diversity* (wald-test p=0.012): Each additional food group the child has eaten increases the risk of undernutrition by 11 %. Could be due to age.
- *Maternal weight* (wald-test p<0.000): Each additional kg. in the mothers weight reduces the risk of undernutrition in the child by 5 %.
- *Maternal BMI* (wald-test p<0.000): For each point more the mother has in BMI the risk of the child being undernourished is reduced by 14 %.

6.2. Logistic regression analysis – multiple factor analysis

The factors found to be significantly related to the different measures of undernutrition through the above-described analysis were included in a logistic regression analysis. Backwards model seeking was performed, removing factors with p>0.05 from the model one by one.

6.2.1 Factors affecting the risk of underweight

The following variables were included as covariates in the initial model: Interviewer, maternal education, vitamin A, illness, water, complementary feeding, number of meals, SES-score, interviewer SES, maternal weight, BMI and time of measurement.

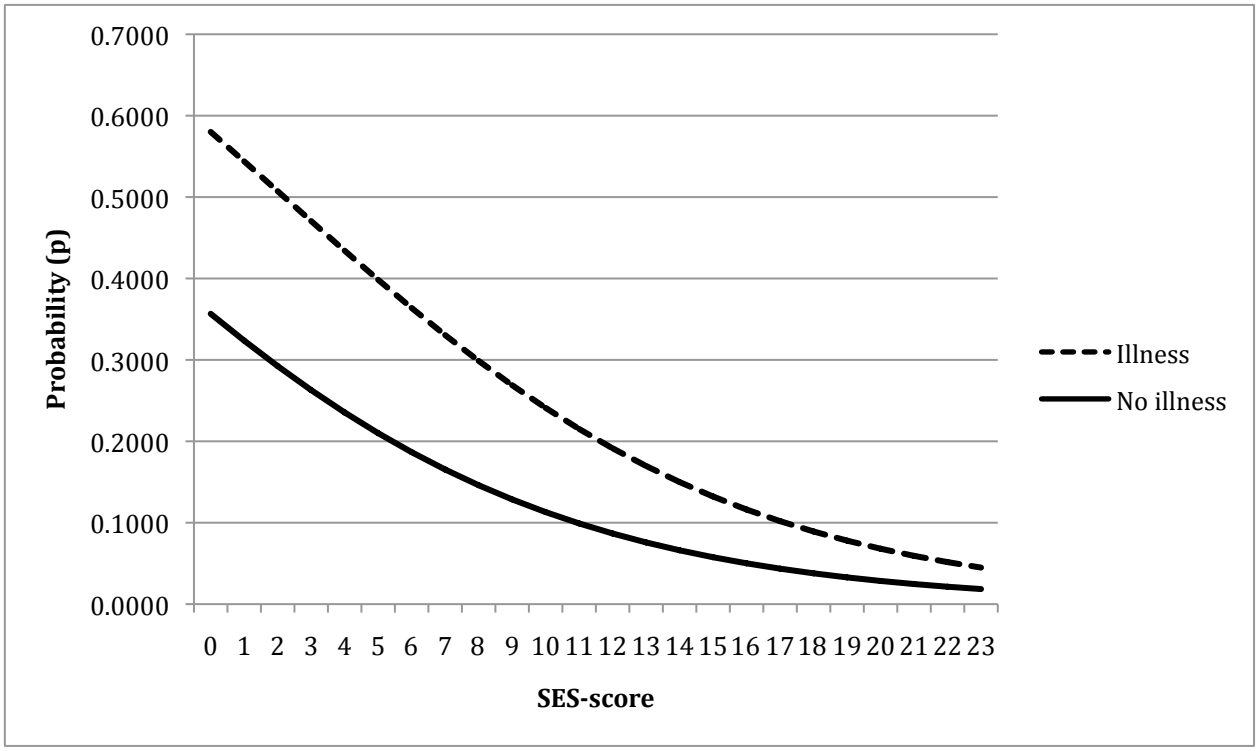
The final model included SES-score and illness the last two weeks (table 19). From the table it can be seen that each additional point on the SES-scale reduces the risk of underweight by 13.7 % while being sick the last two weeks gives the child 2.5 times as high risk of the being underweight. This finding could go both ways: Illness might lead to underweight in the child or underweight in the child might increase the risk of the child falling sick. The model is displayed graphically in figure 9[4] showing the probability of undernutrition with increasing SES-score and for children with and without illness.

Table 19: Factors affecting whether the child is underweight or not.

Parameter	Frequency	ß	Std. Error	Wald-test	df	p-value	OR (CI 95%)
SES score	-	-0.147	0.063	5.458	1	0.019	0.863 (0.763-0.977)
Illness last 2 weeks	-	-	-	-	1	0.015	-
No	241	0.000	-	-	-	-	1
Yes	82	0.913	0.375	5.933	1	0.015	2.492 (1.195-5.195)
α-constant	-	-0.590	0.804	-	-	-	-

[4] Formula used to calculate the probability: $p_{wasting} = \frac{e^{-0.590-0.147\cdot x_{SES-score}+0.913\cdot x_{ill\,ness}}}{1+e^{-0.590-0.147\cdot x_{SES-score}+0.913\cdot x_{ill\,ness}}}$

Figure 9: Probability of underweight



6.2.2 Factors affecting the risk of wasting

The following factors were included in the initial model as covariates: Age in months, age in 1-year groups, age in 6-month groups, vitamin A, breastfeeding, water, complementary feeding, number of meals, maternal weight, maternal BMI, time of measurement and interviewer.

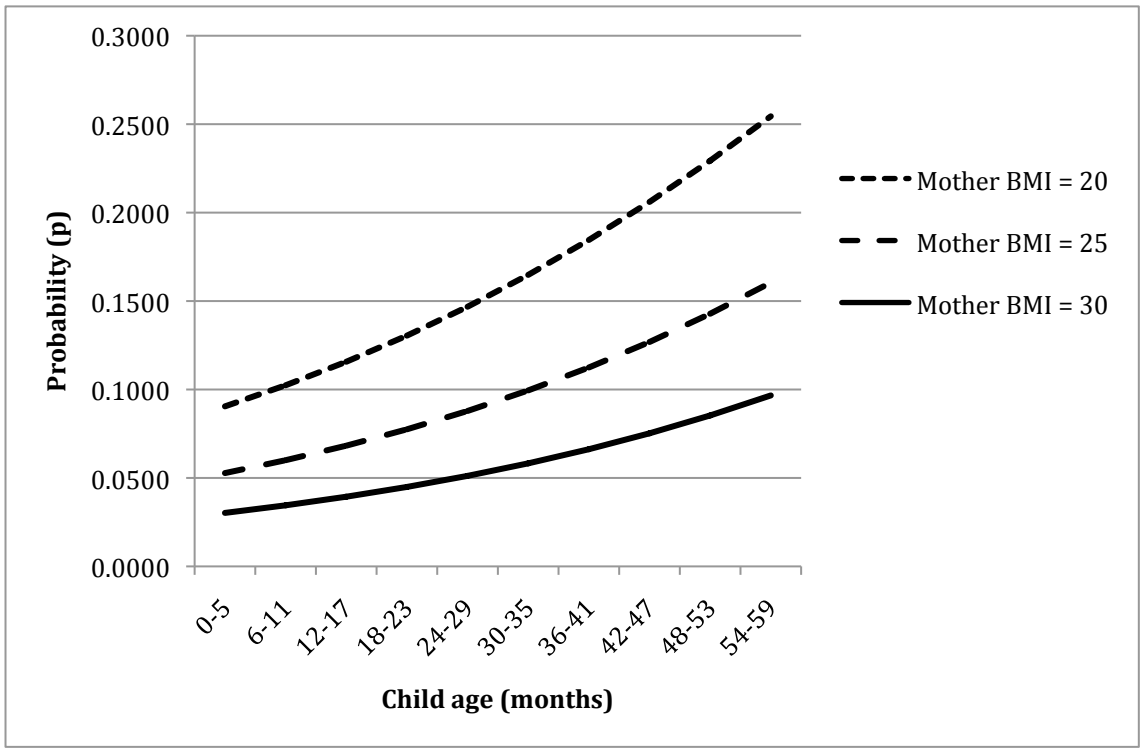
The final model includes age in 6-month groups and maternal BMI (table 20). For every 6 months the child is older the risk of wasting increases by 14.7 %. At the same time each additional point the mother has on the BMI reduces the risk by 10.9 %. Figure 10[5] shows some examples of different children's risk of wasting.

Table 20: Factors affecting whether the child is wasted or not.

Parameter	ß	Std. Error	Wald-test	df	p-value	OR (CI 95%)
Age in 6 month groups	0.137	0.067	4.219	1	0.040	1.147 (1.006-1.308)
Maternal BMI	-0.116	0.052	5.012	1	0.025	0.891 (0.805-0.986)
α-constant	0.012	1.275	-	-	-	-

[5] Formula used to calculate the probability: $p_{wasting} = \frac{e^{0.012+0.137\cdot x_{age\_6mogroups}-0.116\cdot x_{BMI}}}{1+e^{0.012+0.137\cdot x_{age\_6mogroups}-0.116\cdot x_{BMI}}}$

Figure 10: Probability of wasting by age, for children of mothers with different BMI.



6.2.3 Factors affecting the risk of stunting

The initial model included the following variables as covariates: Interviewer, marital status, maternal education, age in 1 year groups, age in 6 month groups, vitamin A, complementary feeding, age of mother, Dietary Diversity, maternal weight, BMI, time of measurement.

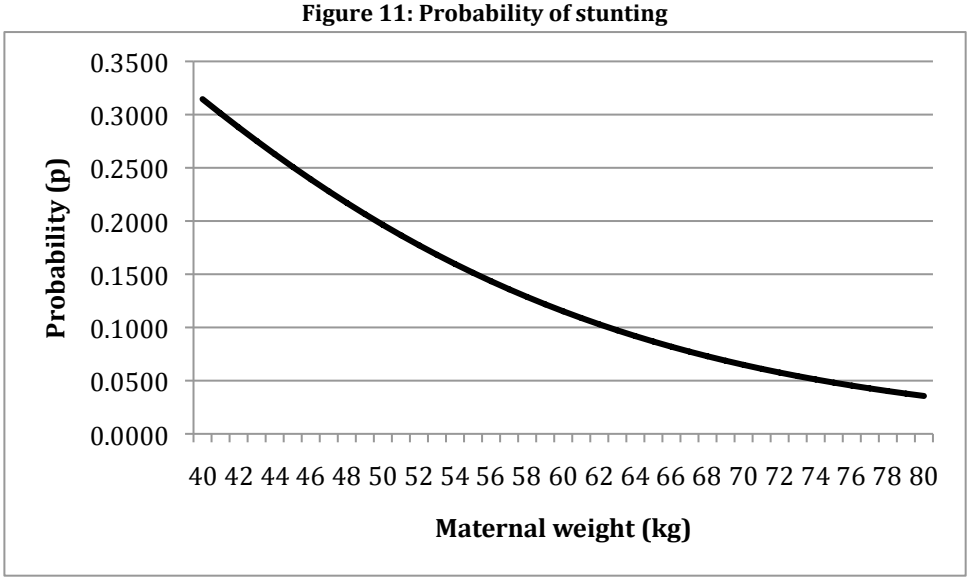
The final model included only maternal weight (table 21). For every kg the mother weighs more the risk of the child being stunted is reduced by 6 %. The relationship is displayed in figure 11[6].

Table 21: Factors affecting whether the child is stunted or not.

Parameter	ß	Std. Error	Wald-test	df	p-value	OR (CI 95%)
Maternal weight	-0.063	0.019	10.955	1	0.001	0.939 (0.905-0.975)
α-constant	1.741	1.119	-	-	-	-

[6] Formula used to calculate the probability: $$p_{stunting} = \frac{e^{1.741-0.063 \cdot x_{maternal\ weight}}}{1+e^{1.741-0.063 \cdot x_{maternal\ weight}}}$$

Figure 11: Probability of stunting



6.2.4 Factors affecting the risk of undernutrition

The following covariates were included in the initial model: Interviewer, marital status, maternal education, age in 1 year groups, age in 6 month groups, vitamin A, illness, breastfeeding, water, complementary feeding, number of meals, number of breastfeedings, age in months, birth weight, Dietary Diversity, maternal weight, BMI, time of measurement.

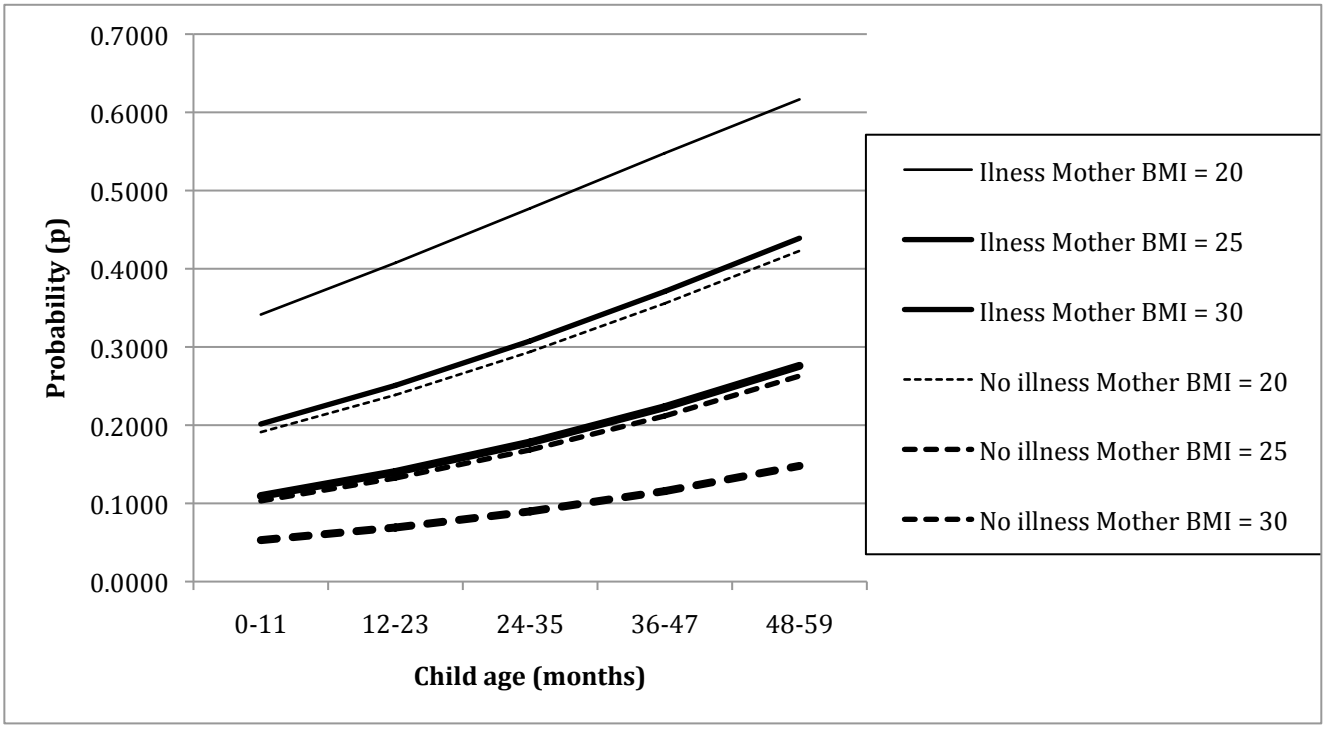
The final model (table 22) included age of the child in 1-year groups, illness and maternal BMI. For every year the child is older its risk of undernutrition increases by 32.7 %. In addition a child being ill the last two weeks has more than twice the risk of undernutrition than a child not being sick. Finally the risk of undernutrition is reduced by 13.5 % for every additional BMI-point of the mother. Figure 12 display the relationship for some selected BMI-values of the mother[7].

Table 22: Factors affecting whether the child is undernourished or not

Parameter	Frequency	ß	Std. Error	Wald-test	df	p-value	OR (CI 95%)
Age in 1year groups	-	0.283	0.105	7.218	1	0.007	1.327 (1.080-1.632)
Illness last 2 weeks	-	-	-	-	1	0.009	-
No	256	0.000	-	-	-	-	1
Yes	87	0.768	0.296	6.744	1	0.009	2.155 (1.207-3.848)
Maternal BMI	-	-0.144	0.040	13.077	1	0.000	0.865 (0.800-0.936)
α-constant	-	1.437	0.977	-	-	-	-

[7] Formula to calculate probability: $$p_{underweight} = \frac{e^{1.437+0.283\cdot x_{age:\_1yrsgroups} -0.144\cdot x_{BMI} +0.786\cdot x_{Il\ln ess}}}{1+e^{1.437+0.283\cdot x_{age:\_1yrsgroups} -0.144\cdot x_{BMI} +0.786\cdot x_{Il\ln ess}}}$$

Figure 12: Probability of undernutrition



6.3. Further planned analysis

The above results should all be considered as raw models, which are subject to further investigation and improvement. Analysis, which are planned to be carried out, are among others the following:

- Further validation of the SES-scale: This will include techniques of scale validation and consider whether occupational variables should be included in the scale. It will also test whether any variables are redundant in the scale.
- Further analysis of correlations between variables: Possible correlations will be explored in order to discover possible confounders and interactions.
- Linear regression analysis: Analysis will be carried out with the z-scores as outcome in order to identify factors not only increasing the risk of manifest undernutrition, but at large affecting the z-scores. This will allow health workers to enhance factors, which affect the z-scores positively and prevent factors, which affect the z-scores negatively, and thus be able to prevent undernutrition.

7. Discussion of the results

7.1. Undernutrition is a problem in Sunyani Municipality

With a prevalence of underweight at 10.6 %, wasting at 10.0 % and stunting at 11.1 % it is clear that there are substantial nutritional problems among the children below 5 years in Sunyani Municipality. When the three types are combined a total of 20.9 % of the children have any one or more nutritional problems, which is equivalent to just above one fifth of the children.

Another interesting group are the children at risk of developing nutritional problems, the children having z-scores between -1 SD and -2SD. In this category another 28.3 % of the children are at risk of underweight, 23.4 % of wasting and 21.4 % of stunting. When the risk groups are combined 36.3 % of the children are at risk of developing a nutritional problem.

In total this means that 57.2% of the children are either having a nutritional problem or are at risk of developing one, which implies that action has to be taken.

7.2. Who are the children at risk?

From the correlation analysis and the logistic regression several factors point at children, who are at increased risk of nutritional problems.

The nutritional status of the mother is a very important factor in that her weight and BMI is related to underweight, stunting and undernutrition. In addition children from families with lower *socioeconomic status* (SES-score) are at higher risk of nutritional problems. Finally the risk of nutritional problems increases with *age* and there is a strong relationship between any *illness* the last two weeks and both underweight and undernutrition.

A number of factors were related to the different categories of undernutrition in the correlation analysis, but not in the logistic regression. Interesting factors are: *Marital status*, where it seems children of mothers, who are not married, have higher risk of stunting and undernutrition. *Maternal education*, as increased education reduces the risk of underweight, wasting and undernutrition. *Maternal age*, as increased age seems to reduce the risk of stunting. And *birth weight*, as increased birth weight seems to reduce risk of undernutrition. Finally the relationship between the different types of undernutrition and the *feeding variables* (water, complementary feeding and breastfeeding) should be explored

further to identify whether their relation to increased risk of the different nutritional problems is direct or due to their correlation with age.

Altogether this allows for an to identification of a number of factors, which should make health workers attentive, even before the nutritional problem is manifest:

- *Children of mothers with poor nutritional status:* Mothers, who has a confirmed low BMI or mothers who look skinny or thin.
- *Children of mothers with low socioeconomic status*: Mothers living in poor housing condition with deprived sanitary facilities and limited resources.
- *Children of mothers, who are not married*.
- *Children of mothers with no or only few years of education*
- *Children of very young mothers*
- *Children, who have been sick recently or frequently*
- *Children born with low birth weight*
- *Children, who are about to have a change in feeding*: The transition from exclusive breastfeeding to complementary feeding and at weaning.

These eight signs are all signs of increased risk of undernutrition in the children.

8. Suggestions on actions to be taken

This part will give some preliminary suggestions on how to act to improve the nutritional situation among children below five in Sunyani. Further, and worked through suggestions will be given in the final thesis report.

8.1. Actions according to the 8 risk factors

Below are some suggested actions towards the eight identified risk factors.

8.1.1 Increased attention to vulnerable mothers

Health workers working at antenatal care clinic and the child welfare clinic (CWC) should pay special attention to mothers who are themselves of poor nutritional status, mothers who are not married, have not been going to school, are of low socioeconomic status or are very young. These mothers should received additional counselling even before the child is born and before any nutritional problems occur. Health workers should spend extra time talking to and listening to these mothers and if more risk factors are prevalent mothers should preferably be visited at home just after birth and when initiating complementary feeding to ensure the mother understands the education given.

8.1.2 Nutrition counselling of sick children

Any health worker treating a sick child should as well make sure to counsel the mother on nutritional aspects. Mothers bringing recently sick children to CWC should be encouraged to feed their children extra well during the next weeks. Children who are undernourished should receive additional attention so that they do not fall sick; this includes counselling mothers of undernourished children on hygiene, prevention of malaria and other preventive measures.

8.1.3 Attention on children with low birth weight

When a child attends CWC the first time health workers should check the birth weight of the child. If the weight is low (<2.5 kg) the mother should in receive extra counselling and education.

8.1.4 Equipping mothers for complementary feeding

During the transition phase from exclusive breastfeeding to complementary feeding and during weaning the child is especially vulnerable. Thus these transitions should receive extra attention during health education and it should be ensured that the mothers are well equipped to give the child healthy and nutritious complementary feeding. Emphasize should be put on the importance of a balanced diet including proteins, vegetables and fruits and on the importance that children receive at least five meals/snacks during the day.

8.2. General actions

The following actions are both addressing the above-mentioned risk groups and aiming to improve nutrition at large. Apart from the analysis in this report they are inspired by the qualitative interviews conducted as part of the survey.

8.2.1 Educating health workers

The health workers interviewed expressed a need to know more about nutrition, especially with concern to new results and practices. Some relevant topics are:

- *Undernutrition is a problem in Sunyani Municipality:* Health workers should know the prevalence of the different nutritional problems found in this survey, as they need to know there is a problem to be able to pay attention to nutrition.
- *Risk factors for undernutrition in Sunyani Municipality:* Health workers should know which factors are predictors of undernutrition in order to be able to prevent nutritional problems before they arise.

- *Interpretation and use of growth charts*: Many health workers find it hard to interpret the growth chart and to explain exactly when a child is underweight. It was found that some health workers only report children with z-scores below -3 SD as underweight. In addition many of the mothers interviewed were not able to comprehend the growth chart and assess the nutritional status of their child. Thus health workers should be better qualified of to explain the growth chart to the mothers.

8.2.2 Aids for educating mothers

Posters with simple pictures of food and meals could help the mothers learn and remember how to feed the children properly especially during complementary feeding. Most mothers know, understand and practise exclusive breastfeeding, the same focus should now be put on complementary feeding, the composition of the meal and the importance of regular meals. The mothers are already taught about this, but posters at CWC-clinics, antenatal care and at health centres could increase remembrance and emphasize the message.

8.2.3 Increased use of home visits

When a child is identified as undernourished it should be sought to do a home visit in the family. This will help understanding the problems and challenges of the mother to better assist her in improving the nutritional status of her child.

8.2.4 Conducting a nutrition seminar

Many of the above suggestions involve the health workers and could be refined with the help of them. This could preferably take place at a nutrition seminar with two parts: 1. Education of health workers about the prevalent nutritional problems, risk groups and the use of growth charts. 2. A workshop developing teaching aids and strategies on how to improve the situation.

9. Perspectives

As mentioned further analysis will be conducted of both the qualitative and quantitative data material. This will lead to additional and better-confirmed results and intervention suggestions. In addition any reader of this report and any reactions on the results will be gratefully received and taken into consideration.