Bringing Nutrition Actions to Scale in Iringa, Njombe and Mbeya Regions of Tanzania

In-depth analysis of the factors associated with stunting

Joint research study

Concern Worldwide and

Centre for Research on the Epidemiology of Disasters (UCL)

Study Report version 3

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List of acronyms

CI	Confidence Interval
CRED	Centre for Research on the Epidemiology of Disasters
FPDS	Farm Production Diversity Score
HAZ	Height-for-Age Z score
HDDS	Household Diet Diversity Score
IDDS	Individual Diet Diversity Score
ICFI	Infant and child feeding index
IYCF	Infant and Young Child Feeding
MAD	Minimum Adequate Diet
MDD	Minimum Diet Diversity
MMF	Minimum Meal Frequency
MoH	Ministry of Health
MUAC	Mid Upper Arm Circumference
UNICEF	United Nations Children Fund
OR	Odds Ratio
PLW	Pregnant and Lactating Women
SD	Standard Deviation
SUN	Scaling Up Nutrition
TDHS	Tanzania Demographic and Health Survey
WAZ	Weight-for-Age Z-score
WHZ	Weight-for-Height Z-score

1 Introduction

Concern Worldwide joined UNICEF in a partnership to scale up nutrition (SUN) interventions to address high stunting prevalence among children in Tanzania. The project "Bringing nutrition actions to scale in Iringa, Njombe and Mbeya regions of Tanzania" started in April 2013 and focuses on interventions during the first 1000 days of a child's life (from conception to 24 months of age).

At the start of the 5 year project, Concern Worldwide collected baseline information from five different sources: an anthropometric and Infant and Young Child Feeding (IYCF) practice survey; a district level survey to assess the capacity of the local government authority at district level to support nutrition programmes; a barrier analysis; a market survey, and a crop/livestock survey.

Concern Worldwide and the Centre for Research on the Epidemiology of Disasters (CRED) agreed to collaborate in the analysis of the data collected during the anthropometric and IYCF survey, with the aim to investigate factors associated to stunting. The collaboration foresaw three main deliverables: first, the draft results in table format; second, a report summarising methods and results, and third, a scientific paper to be submitted to a peer-reviewed journal. After consultation with UNICEF, it was agreed to combine part of the report and the paper to produce a final report, which is presented in this document. It reviews the importance of stunting in section 2, describes the study areas in section 3, the methods used in section 4, the results in section 5. Section 6 discusses the results and presents some policy and operational recommendations.

2 Short review on stunting

Linear growth failure is a major public health problem in Africa, where more than one third of the children under 5 are too short for their age [1,2]. Extensive research has shown the health, economic and intergenerational consequences of stunting: higher risk of dying [3,4], poorer psychomotor, mental development and school achievement [5–7], loss of human capital and economic productivity in adulthood [8–10], increased risk of chronic diseases [11] and reduced maternal reproductive outcomes [12].

Stunting often begins in utero [13], as maternal nutrition is the first determinant of the child nutritional status [1]. It continues generally during the first two years after birth [14,15]. Although the pathogenesis of stunting is not yet well understood [16], studies have shown that inadequate nutrient intake, infections, unsafe water and poor care are among the main determinants of undernutrition [17–19].

Other determinants of child undernutrition in developing countries include maternal education [20,21], socio-economic status [21–23], residence [24,25] and poor access to health services [26,27].

There is increasing international recognition that efforts to prevent stunting are likely to benefit multiple short and long term outcomes, at individual, community and country levels [8,10]. This is reflected in the number of governments affiliated to the Scaling-Up Nutrition (SUN) movement (http://scalingupnutrition.org), which supports countries in improving nutrition through a multisectoral developmental approach, as well as in the inclusion of nutrition related goals in the World Health Assembly targets, Millennium Development Goals and the proposed Sustainable Development Goals.

Tanzania, a member of SUN, faces high burden of stunting. Most recent results from the Tanzania National Nutrition Survey conducted in 2014 report that 34.7% of the children under 5 are stunted [28]. This represents an improvement from the last Demographic and Health Survey (2010) that reported a stunting prevalence of 42%. In central and southern highlands zones, the prevalence of chronic malnutrition reaches 50% [29]. In these zones, the Government of Tanzania, UNICEF and Concern Worldwide, an international non-governmental organisation, are implementing the "Bringing nutrition actions to scale in Iringa, Njombe and Mbeya regions of Tanzania" project. It aims to reduce the prevalence of stunting by 10 percentage points over 5 years, through interventions targeting women and children during the 1,000 days window of opportunity, as well as strengthening capacities of local government authorities. At the beginning of the project, baseline information was collected on infant and young child feeding (IYCF) practices, child and maternal nutritional and health status, and household socio economic situation.

3 Methods

3.1 Study area

The survey was conducted in the regions of Iringa, Njombe and Mbeya. These regions are in the southern highlands of Tanzania and are contiguous. They have a total population of about 4.4 million people[1], 72% of whom are rural. They receive the highest rainfall in the country and have the coldest weather in the country. According to the 2010 Tanzania Demographic and Health Survey, the prevalence of stunting in these regions are some of the highest in the country. In the southern highlands, the

[1] 2012 Census report

fertility rate is about 5.4 per woman and under 5 mortality rate is 102 deaths per 1,000 live births. The reported literacy rate is 80%. About 69% of the total population depends on the agricultural sector as their main economic activity.

3.2 Survey procedure

The survey methodology has been described in detail in the document "Outline for the nutrition baseline surveys in Iringa, Njombe and Mbeya region", prepared by Concern Worldwide. Briefly, it was a household survey using a stratified multi-stage cluster sampling method. Sixty three clusters were selected by probability proportional to the size using ENA delta software [30] in each region. Twenty households in each cluster were chosen by random sampling, using a random number table. A complete list of households with children under the age of 5 in each cluster was prepared before the survey date by the survey team with the involvement of village leaders and key informants. Households were visited for verification if necessary. Sample size was calculated to detect a 10 percentage point reduction in stunting by region. Power was set at 80%, level of confidence at 95% (one-tailed test), design effect at 1.5 and non-response at 10%. A sample of 501 children in the age group 24-47 month per region was required. A total of 1,253 households with children under 5 were targeted in each region to achieve the required sample size. Anthropometric measurements were taken from children 0-59 months and nutritional indexes calculated using WHO standards. Information on infant and young child feeding practices were collected for children 0-23 months.

3.3 Data management

CRED received the survey dataset from Concern Worldwide and checked it for duplications and improbable values. Clarifications were requested and obtained from George M. Mutwiri. Variables were recoded and reclassified to facilitate analysis. The complete list of new variables with coding and definition is shown in Annex 1. Anthropometric indexes were calculated using the ENA software [30]. WHO standards were used [31].

As far as feeding practices are concerned, following variables were created:

1. Children aged 0 to 5 months who were exclusively breastfed. This was defined as receiving only breastmilk and based on the simultaneous appropriate answer of multiple questions.

2. Individual Diet Diversity Score (IDDS) [32]: Number of food groups consumed by a child 6 to 23 months of age over a 24 recall period. It includes 7 food groups: cereals, grains, tubers; Vitamin A rich plant foods; other fruits and vegetables; meat, poultry, fish; eggs; pulses, legumes, nuts; milk and milk products.

3. Minimum Diet Diversity (MAD) [33]: this is the proportion of children 6 to 23 months of age who received food from four or more food groups. It uses 7 food groups as the IDDS.

4. Minimum Meal Frequency (MMF) [33]: proportion of breastfed and non-breastfed children 6 to 23 months of age who receive solid, semi-solid or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more. Minimum is defined as:

- 2 times for breastfed infants 6 to 8 months
- 3 times for breastfed children 9 to 23 months
- 4 times for non-breastfed children 6 to 23 months.

Meals include both meals and snacks.

5. Minimum Acceptable Diet (MAD) [33]: proportion of children 6 to 23 months of age who receive at least the minimum diet diversity and the minimum meal frequency. It is calculated separately for breastfed and non-breastfed children. For breastfed children, it corresponds to the children who reach both MDD and MMF. For non-breastfed children, milk feeds are excluded from the calculation of diet diversity and considered separately to avoid double counting.

6. An Infant and child feeding index (ICFI), following the principles of the method proposed by Ruel and Menon [34]. It is based on age-specific scoring system that gives points for positive practices in terms of breastfeeding, bottle feeding, diet diversity and meal frequency. Optimal feeding practices were defined for three age groups: 6-8; 9-11; 12-23. Table 1 indicates the variables used and the scoring system. Differently from the original index, our ICFI does not include food frequency over the past 7 days since these data were not available.

Table 1: Infant and child feeding index: variables and scoring system used by age group

Variable	**6-8**	**9-11**	**12-24**
Breastfeeding	No = 0; Yes =+2	No = 0; Yes =+2	No = 0; Yes =+2
Uses bottle	No=1; Yes=0	No=1; Yes=0	No=1; Yes=0
Dietary Diversity	Based on 7 food groups 0=0	Based on 7 food groups 0=0	Based on 7 food groups 0=0

	1-3=1 4 +=2	1-3=1 4 +=2	1-3=1 4 +=2
Meal Frequency	0 meals/day =0 (low) 1 meal/day=1 (medium) 2 meals/day= 2 (high)	0 meals/day =0 (low) 1-2 meals/day=1 (medium) 3+ meals/day= 2 (high)	0-1 meals/day =0 (low) 2-3 meals/day=1 (medium) 4+ meals/day= 2 (high)
Total score	7 points	7 points	7 points

7. The proportion of children receiving good feeding practices. We followed the principles of the composite index presented by Guevarra et al [35]. This is a combined index that tries to overcome the relative small sample size of the age subgroups for each of which specific feeding practices apply. The idea is to add up the number of children who score the highest in terms of ICFI (=optimal feeding practices for children between 6 and 23 months of age), and the children who are exclusively breastfed (= optimal feeding practice for children between 0 and 5 months of age). Table 2 indicates how this index is calculated.

Table 2: Good practice index

		Classification	
		Good	Not good
Age	< 6 months	Exclusively breastfed	Not exclusively breastfed
	> 6 months	ICFI=7	ICFI<7

8. Household Diet diversity score (HDDS): this is defined as the number of food groups consumed in the household in the previous 24 hours. It includes 12 food groups: cereals; white tubers; vegetables; fruits; meat; eggs; fish; beans, peas, lentils; dairy products; oils and fats; sugar and honey; condiments. We followed the definition of the FAO [32]. As there is no defined threshold, the HDDS was divided in terciles (0-4; 5-8; 9-12).

9. Farm Production Diversity Score (FPDS): It was calculated as the HDDS, but considering the food groups produced instead of consumed by each household. There is no defined threshold. We used the following classification in the analysis: 0; 1-2; 3-5; 6-12.

Despite important differences in the population size of the three regions, similar samples (in terms of size) were drawn. We therefore applied sampling weights in the analysis to ensure the actual representativeness of the survey results at the regional level. Data from the Tanzanian Population and Housing Census 2012 report was used to compute sampling weights.

3.4 Data analysis

The analysis is composed by two parts:

1. Determinants of stunting among children aged 6 to 59 months;
2. Focus on infant and young child feeding practices among children aged 0 to 23 months.

3.4.1 Methodology part 1 – determinants of stunting

The analysis of factors associated with stunting was divided by age groups: 6 to 23 and 24 to 59 months, and conducted for the entire sample and broken down by region. Univariate analysis was conducted to describe baseline socio-demographic and clinical characteristics of the sample using simple frequency distribution. Associations (crude effect) between stunting and socio-demographic and clinical variables were investigated using Pearson's chi-square test. A multivariate logistic regression model was constructed to identify factors associated with stunting (net effect). We included in the model variables expected to be associated with stunting based on the available literature [14,20,36,37] and included variables at child, maternal, household and contextual level. The variance inflation factor was used to check possible multicollinearity among predictors. Odds ratios (OR), 95% confidence intervals (CI) and p-values were obtained. P-values <0.05 were considered significant. The analysis was conducted in STATA IC/12.1 for Windows and SPSS 20.0. Anthropometric indicators were calculated with ENA software.

3.4.2 Methodology part 2 – focus on IYCF

We conducted a descriptive analysis of IYCF practices. Means and SD were computed for continuous variables, and frequencies and proportions were computed for categorical variables. Analysis was disaggregated by age groups: 0-5, 6-11, 12-17 and 18-23.

We then calculated the ICFI and broke it down by component; associations with height-for-age Z-score were investigated.

4 Results

The original dataset included 3,713 observations of children 0-59 months. Of these, 18 did not have information on the region of provenience. The final sample size of children 0-59 months of age was therefore 3,695. Of these, 1, 791 were in the age group 0-23 months, based on their age as indicated by the caregiver.

Table 3: Sample size and age groups breakdown

	Sample size
Total number of children 0 - 59 on which data was collected	3,713
Case removed due to missing region	18
Total available sample 0 - 59 months for analysis	3,695
0-23	1,791
24-59	1904
6-23	1360
6-59	3264
Implausible anthropometric measurements	17

4.1 Descriptive results – overall

Tabulated results are presented in annex 2. Tables 4 to 7 show frequencies and proportions of all variables included in the dataset. These are presented for three age groups: 0-23, 24-59, and 0-59 months. Descriptive statistics are presented by child, maternal, household and contextual characteristics. This section presents only main results.

The greatest majority of the interviewed households live in rural areas (80%); about 65% of the population live in Mbeya, 15% in Njombe and 20% in Iringa.

In terms of nutritional status, almost half of the children are stunted, with a higher prevalence among the oldest children (overall prevalence: 43.2%, 35.3% among 0-23 and 49.5% among 24-59). Little wasting is present (2.2% in the entire sample), whereby younger children are more subject to it than older ones (3.4% in the 0-23 month group and 1.3% in the 24-59 month group). The prevalence of underweight is 13.8% of the children 0-59 (12.5 among the 0-23 and 14.9% 24-59). Average HAZ score is -1.76 for children 0-59 (sd: 1.53), whereby -1.49 for the children 0-23 (sd: 1.64) and -2.02 (sd: 1.4) for children in the age group 24-59 months.

Overall, children are distributed evenly between female and male, and as expected among age groups. As far as the age group 0-23 months (the only group for which this data was collected), the majority of the children live with both parents and remains with an adult relative if the mother needs to leave the house. Siblings younger than 15 represent 30% of the alternate care. With regard to the feeding practices of the children 6-23 month old, only 11 children (i.e. 0.8% of the group) reached the minimum adequate diet, whereby 15.2% reached the minimum diet diversity and 26.8 the minimum meal frequency. Optimal feeding practices were achieved by 3.9% of the children according to the Infant and child feeding index. Considering also the group 0-5, 11.9% of the children experienced age-appropriate feeding practice. Further details on feeding practices are presented in section 4.3. 40% of the children reported illnesses in the two weeks before the survey; 45% received deworming treatment and 78.2% Vitamin A supplementation in the previous 6 months.

With regard to the maternal characteristics, very few mothers in the entire sample are malnourished and the majority has had only one child in the last 5 years. Few mothers are pregnant, while the majority is breastfeeding. Information on maternal habits during pregnancy was collected only for caretakers of children in the group 0-23 months. Comparing their habits during pregnancy with the time before, 64.4% worked less; 16.6% eat more and 43.6% less; 35.6% reduced food diversity and 18.2% increased food diversity. 63.7% received iron supplementation. 41.4% of the women received advice on child and maternal nutrition. In terms of decision making on how to feed the child, 73% of the respondents make this decision themselves, while in 14.9% of the cases is done jointly with their partner/husband. 40.3% of the respondents have good knowledge about hand washing practices (see definition in annex 1).

As far as the household characteristics are concerned, almost 70% of the households have access to improved water, but only about 7.2% have a functional hand washing station. Average HDDS is 5, with only 3.3% of the households consuming food from more than 8 groups. In terms of FPDS, mean value is 3.3. Around 80% of the households produce between 1 and 5 food groups. One fourth of the households own a home/kitchen garden, whose production is mainly used for own consumption. 80% of the households buy fresh food either daily or 2/3 times a week. 63% of the households produce animal based food, but only 50% consume it; 43.5% of the households produce vitamin A rich food, and 82% consume it. 79.4% of the households use iodised salt.

4.2 Factors associated to stunting

4.2.1 Bivariate and multivariate analysis for children 6 to 23 months old

Table 4 shows the significant results of the bivariate and multivariate logistic regression for children aged 6 to 23 months, for the entire sample and broken down by region. The complete list of results (i.e. including statistically non-significant variables) are presented in table 13 (Annex 6.2.2).

Children in Njombe and Iringa have higher odds of being stunted than children in Mbeya. Children in their second year of life have higher odds to be stunted than younger children. Male children have higher odds than female.

In the entire sample, children aged 6-23 month had lower odds of stunting if received deworming treatment, came from a household consuming 5 or more food groups or that has a home garden. In Njombe, children from households producing animal-based food have lower odds of stunting. In Iringa, using iodised salt was also found protective. Risk factors in the same age group are maternal absence for 4-7 hours and production of vitamin-A-rich food. In Njombe and Iringa, children whose mother is currently pregnant have higher odds of stunting. In Iringa, two or more births in the last 5 years, reduced frequency of buying fresh vegetables and improved knowledge of hand washing practices were other risk factors.

Table 4: Crude and adjusted odds ratio (95% CI) for stunting among children aged 6 to 23 months, overall and disaggregated by region, according to child, maternal and household characteristics, southern highlands, Tanzania, 2013 (only significant results are shown)

VARIABLES	Overall (N=929)		Mbeya (N=374)		Njombe (N=348)		Iringa (N=357)	
	Crude OR	Adjusted OR	Crude OR	Adjusted OR	Crude OR	Adjusted OR	Crude OR	Adjusted OR
Male sex	2.15*** (1.65 - 2.81)	2.17*** (1.52 - 3.09)	2.35*** (1.57 - 3.50)	2.90*** (1.76 - 4.80)	1.67*** (1.15 - 2.42)	2.13*** (1.27 - 3.60)	2.04*** (1.41 - 2.95)	2.45*** (1.44 - 4.16)
Child age								
6-11	1	1	1	1	1	1	1	1
12-24	2.70*** (2.02 - 3.62)	3.91*** (2.49 - 6.12)	2.730*** (1.751 - 4.256)	4.63*** (2.47 - 8.67)	2.92*** (1.97 - 4.34)	3.04*** (1.68 - 5.50)	2.63*** (1.75 - 3.95)	4.74*** (2.40 - 9.37)
Receiving deworming treatment		0.64** (0.41 - 0.99)		0.53** (0.30 - 0.93)			1.89*** (1.28 - 2.79)	
Mother hours away from home								
0 hours	1	1	1	1				
1-3 hours	0.85 (0.59 - 1.21)	1.00 (0.64 - 1.59)	0.79 (0.48 - 1.32)	0.96 (0.53 - 1.76)				
4-7 hours	1.64*** (1.17 - 2.30)	1.93*** (1.21 - 3.07)	1.90** (1.14 - 3.14)	2.25** (1.20 - 4.19)				
8-24 hours	0.83 (0.53 - 1.29)	1.07 (0.58 - 1.98)	0.79 (0.39 - 1.60)	1.00 (0.42 - 2.39)				
Mother currently pregnant					2.98** (1.05 - 8.51)	4.26** (1.08 - 16.87)		6.64** (1.23 - 35.66)
Food types during last pregnancy								
Fewer							1	
The same							1.79** (1.13 - 2.84)	
More							1.10 (0.64 - 1.88)	
Receiving husband support during pregnancy					0.61** (0.38 - 0.99)			
Births in the last 5 years								
One								1
Two or more								2.02** (1.11 - 3.66)
Household Diet Diversity Score								
0-4	1	1	1	1			1	
5-8	0.66*** (0.50 - 0.86)	0.61** (0.41 - 0.92)	0.66** (0.44 - 0.98)	0.63 (0.36 - 1.09)			0.61*** (0.42 - 0.89)	

9-12	0.25*** (0.09 - 0.66)	0.15*** (0.04 - 0.53)	0.20** (0.04 - 0.95)	0.14** (0.02 - 0.96)			0.10** (0.01 - 0.82)	
Owning a home garden		0.58** (0.38 - 0.89)						
Production of animal based food					0.67** (0.46 - 0.98)	0.50** (0.26 - 0.95)		
Production of Vitamin A rich fruits and vegetables	1.43*** (1.09 - 1.87)	1.71** (1.06 - 2.76)			1.59** (1.09 - 2.32)			
Frequency of buying fresh food								
Daily					1			1
2-3 times per week					1.20 (0.78 - 1.85)			2.19** (1.14 - 4.23)
Once a week					1.15 (0.66 - 2.00)			1.47 (0.53 - 4.05)
Less often					2.28** (1.19 - 4.39)			1.11 (0.41 - 2.99)
Using iodised salt	0.72** (0.53 - 0.97)						0.54*** (0.34 - 0.84)	0.41*** (0.21 - 0.79)
Knowledge of hand washing practices								
Poor								1
Satisfactory								3.10*** (1.33 - 7.24)
Good								1.13 (0.47 - 2.71)
Improved water source							0.48*** (0.30 - 0.76)	
Urban residence	0.68** (0.49 - 0.95)						0.50*** (0.30 - 0.81)	
Region								
Mbeya	1	1						
Njombe	1.34** (1.03 - 1.76)	1.77** (1.11 - 2.80)						
Iringa	1.19 (0.91 - 1.55)	1.59** (1.06 - 2.40)						

Level of significance: *** p<0.01, ** p<0.05; OR= Odds ratio.

4.2.2 Bivariate and multivariate analysis for children 24 to 59 months old

Table 5 shows the significant results of the bivariate and multivariate logistic regression for children aged 24 to 59 months, for the entire sample and broken down by region. The complete list of results (i.e. including statistically non-significant variables) are presented in table 14 (Annex 6.2.3).

Children in Njombe and Iringa have higher odds of being stunted than children in Mbeya. Children in their third year of life have higher odds to be stunted than older children. Male children have higher odds than female.

Overall, children aged 24-59 month from households with access to improved water source or with a functioning water station had lower odds of stunting. Knowledge of hand washing practices protects against stunting in Iringa, while in Mbeya children from households consuming animal based food have lower odds. In the entire sample, children whose mother was currently breastfeeding have higher odds of stunting. Short maternal absence (1-3 hours) was a protective factor in Mbeya, while longer absence (4-7 hours) was a risk factor in Njombe. Urban residence was protective in Njombe and a risk factor in Mbeya.

Table 5: Crude and adjusted odds ratio (95% CI) for stunting among children aged 24 to 59 months, overall and disaggregated by region, according to child, maternal and household characteristics, southern highlands, Tanzania, 2013 (only significant results are shown)

VARIABLES	Overall (N=1618)		Mbeya (N=561)		Njombe (N=517)		Iringa (N=535)	
	Crude OR	Adjusted OR	Crude OR	Adjusted OR	Crude OR	Adjusted OR	Crude OR	Adjusted OR
Child age								
24-35	1	1	1	1	1	1		
36-47	0.73** (0.57 - 0.94)	0.71** (0.54 - 0.95)	0.70** (0.49 - 1.00)	0.69* (0.45 - 1.05)	0.68** (0.47 - 0.99)	0.68* (0.44 - 1.06)		
48-59	0.59*** (0.44 - 0.78)	0.60*** (0.44 - 0.83)	0.52*** (0.35 - 0.77)	0.53*** (0.33 - 0.85)	0.64** (0.43 - 0.97)	0.61** (0.37 - 0.98)		
Male sex	1.30** (1.04 - 1.61)	1.28** (1.00 - 1.64)						
Mother currently breastfeeding	1.79*** (1.20 - 2.68)	1.97*** (1.18 - 3.29)		2.82** (1.23 - 6.47)				
Mother currently pregnant					2.28** (1.05 - 4.93)	2.81** (1.20 - 6.60)		
Mother hours away from home								
0 hours				1	1	1	1	
1-3 hours				0.58** (0.36 - 0.94)	0.98 (0.63 - 1.53)	1.20 (0.72 - 2.00)	1.32 (0.86 - 2.01)	
4-7 hours				0.81 (0.50 - 1.30)	1.64** (1.07 - 2.52)	1.66** (1.01 - 2.73)	1.63** (1.09 - 2.44)	
8-24 hours				0.97 (0.55 - 1.71)	1.53* (0.97 - 2.39)	1.95** (1.15 - 3.31)	1.31 (0.76 - 2.27)	
Improved water source		0.70** (0.52 - 0.93)		0.58*** (0.39 - 0.87)	1.56** (1.06 - 2.29)			0.63** (0.40 - 0.99)
Functional hand washing station		0.63** (0.40 - 0.98)		0.43** (0.18 - 0.99)				
Knowledge of hand washing practices								
Poor							1	1
Satisfactory							0.81 (0.51 - 1.28)	0.80 (0.47 - 1.36)
Good							0.55** (0.34 - 0.90)	0.47** (0.26 - 0.85)

Household Diet Diversity Score								
0-4	1		1					
5-8	0.66*** (0.53 - 0.83)		0.65** (0.47 - 0.91)					
9-12	0.96 (0.52 - 1.80)		1.25 (0.59 - 2.66)					
HH consuming animal based food	0.67*** (0.54 - 0.84)		0.63*** (0.46 - 0.86)	0.63** (0.42 - 0.94)				
Farm Production Diversity Score								
No production	1						1	
1-2 food groups	0.90 (0.67 - 1.20)						1.79** (1.01 - 3.14)	
3-5 food groups	1.56** (1.04 - 2.33)						2.33*** (1.38 - 3.93)	
6-12 food groups	1.34 (0.92 - 1.94)						3.16*** (1.72 - 5.78)	
HH production of animal based food			0.72** (0.52 - 0.99)				1.45** (1.04 - 2.02)	
Production of vitamin A rich fruits and vegetables							2.25*** (1.63 - 3.10)	
Owning a home garden							1.99*** (1.44 - 2.75)	
Frequency of buying fresh food								
Daily							1	
2-3 times per week							1.46** (1.00 - 2.11)	
Once a week							1.64* (0.99 - 2.72)	
Less often							1.30 (0.80 - 2.13)	
Urban residence			1.74*** (1.18 – 2.57)	2.02*** (1.21 – 3.39)		0.61** (0.39 – 0.95)	0.47*** (0.31 – 0.72)	
Region								
Mbeya								
Njombe	1.83*** (1.47 - 2.29)	1.77*** (1.33 - 2.35)						
Iringa	1.27** (1.02 - 1.59)	1.37** (1.04 - 1.79)						

Level of significance: *** p<0.01, ** p<0.05; OR= Odds ratio; HH=Household

4.3 Focus on IYCF

Table 6 displays descriptive results about the nutritional status and feeding practices of children 0 to 23 months of age. Results are broken down by following age groups: 0-5; 6-11; 12-17; 18-23.

In terms of nutritional status, prevalence of stunting is highest in the age groups 12-17 and 18-23. Wasting is highest in the age group 6-11.

Almost all children are breastfed in the first two age groups and continued breastfeeding at year 1 is 91.1%. Slightly more than half of the respondents reported their child as being still exclusive breastfed in the age group 0-5. Exclusive breastfeeding prevalence calculated by cross checking multiple answers was however lower (38.6%). Half of the children aged 0-5 months receive water, and more than one third cereals. Number of food groups consumed increases with age: cereals, pulses, non-vitamin A rich fruit and vegetables are the most commonly eaten foods. Meat, fish, eggs and milk are eaten by a minority of children.

Minimum Meal Frequency was achieved by 24%, 27% and 29% of the children in the age group 6-11; 12-17 and 18-23 respectively; Minimum Diet Diversity was achieved by only 10.5%, 17% and 18.5%. Overall, less than 1% of the children received the minimum adequate diet.

Table 6: Nutritional status and feeding practices of children aged 0 to 23 months, by age group

Variable	sample size	0-5	6-11	12-17	18-23	0-23	test
		% or *[mean (SD)]	% or *[mean (SD)]	% or *[mean (SD)]	% or *[mean (SD)]	% or *[mean (SD)]	
Total sample		**431**	**481**	**451**	**428**	**1791**	
Stunting	1781	11.3	27.1	46.1	54.1	35.3	<0.001
mean HAZ	1781	-0.47* (1.43)	-1.34* (1.30)	-1.90* (1.33)	-2.17* (1.14)	-1.47* (1.45)	<0.001
Wasting	1784	1.2	5.7	4	2.5	3.4	0.0169
mean WHZ	1784	0.80* (1.28)	0.19* (1.24)	-0.02* (1.14)	0.13* (1.1)	0.27 * (1.23)	<0.001
Underweight	1789	2	12.7	17.5	16.5	12.5	<0.001
mean WAZ	1789	0.18 * (1.21)	-0.67 * (1.27)	-0.94 * (1.24)	-0.99 * (1.13)	-0.61 * (1.30)	<0.001
Registered in a nutrition programme	1791	1.3	0.6	0.7	0.4	0.7	small sample

Proportion of breastfed children	1764	98.2	95.3	88.6	44.6	81.3	<0.001
Continued breastfeeding at 1 year (12-15 months of age)	319			91.1			
Did the child receive							
Water	1766	50.4	93.2	95.3	93.4	84.2	
Infant formula	1765	1.1	0.4	1.5	0.4	0.8	small sample
Milk other than breastmilk	1765	1.4	7.3	9.5	9.1	7	0.0014
Juice	1766	2.6	7	9.8	16.6	9.2	<0.001
Other liquids	1766	11.1	40.6	47.2	54.6	39.2	<0.001
Yoghurt	1765	0	1	2.3	4.2	1.9	0.006
How old introduced first food	1736						<0.001
Still exclusive breastfed		56.5	2.6	1.8	0.6	14.2	
6 month or older		0.1	35.3	44.8	46.4	32.4	
Younger than 6 months		43.3	62.2	53.4	52.9	53.3	
Exclusive breastfed (recalculation)	431	38.6					
Did the child eat							
Micronutrient powders	1724	0.8	3.5	4.9	4.1	3.4	0.0639
Lipid based nutrient supplements	1723	0.5	3.7	5.1	4.7	3.6	0.0511
Iron fortified solid…food	1723	0.3	0.5	1.2	0.2	0.5	small sample
Iron fortified infant formula	1724	0.1	0.1	0.7	0	0.3	0.1228
Cereals	1766	34.7	90.3	94.2	97.9	80.7	<0.001
Vitamin A rich plant foods	1765	0.8	9.4	14.9	17.2	10.8	<0.001
Other fruits or vegetables	1763	3.4	36.1	56.4	64.4	41.1	<0.001
Meat, poultry, fish, seafood	1765	0.3	17.7	24.6	28	18.2	<0.001
Eggs	1763	0.2	2.1	3.1	4.9	2.7	0.002
Pulses/legumes/nuts	1765	2.4	29.1	39.3	43.6	29.4	<0.001
Milk	1764	2.8	8	10.5	10.6	8.1	0.007
Food groups	1337		1.9* (0.1)	2.5* (0.1)	2.7* (0.1)	2.3* (0.04)	
Did the child receive							
Vitamin A dose	1479	18.7	66.4	88.3	88.4	72.8	<0.001
Deworming treatment	1459	3.9	23	60.2	71.6	45.3	<0.001
How many times solid/semi solid/soft food	1791	0.18* (0.6)	1.44* (1.1)	2.08* (1.03)	2.34* (0.95)	1.51* (0.95)	<0.001
Meal Frequency (MF)	1326	0.86* (1.8)	2.41* (1.8)	2.97* (1.6)	3.2* (1.4)	2.36* (1.9)	<0.001
Minimum Meal Frequency	1336		24.5	27.4	28.7	26.8	0.4563
Minimum Diet Diversity	1360		10.5	16.9	18.5	15.2	0.0155
Minimum Adequate Diet	1337		0.2	0.1	2	0.6	small sample

ICFI	1322		5.2*	4.9*	4.2*	4.8*	<0.001
% of children with good practices feeding practices	1753	38.6	5.4	5.6	0.7	11.9	<0.001

The distribution of the ICFI components by children's age groups is presented in Table 7. Breastfeeding was almost ubiquitous and prolonged (44% of the children aged 18-23 months were still breastfed). Bottle-feeding was almost never resorted to. The proportion of children eating with low frequency decreases only little with age. While the majority of children in the youngest group eats with high frequency, the majority of children in the older groups enjoy only a medium frequency. In terms of diet diversity, the majority of the children in all age groups eat from 1 to 3 food groups only.

Table 7: ICFI component distribution by age group

Component	**6-11**	**12-17**	**18-23**	**6-23**
Breastfeeding, %	95.3	88.6	44.6	76.3
Bottle-feeding, %	2	2	1.1	1.7
Meal Frequency, %				
Low (0)	15.9	14.9	9.1	13.3
Medium (1)	32.3	59.4	61.2	50.7
High (2)	51.8	25.7	29.8	36
Diet Diversity, %				
Low (0)	8.1	5.6	1.2	5
Medium (1)	84.1	79.4	92.5	82.1
High (2)	7.8	15	16.4	13
ICFI				
Minimum	2	1	2	1
Maximum	7	7	7	1
Median	6	5	4	5
Mean (SD)	5.3 (1.03)	5.0 (1.1)	4.3 (1.15)	4.9 (1.15)

SD=standard deviation

The ICFI distribution per age group is presented in Figure 1. ICFI peaks around 5 and 6 in the age groups 6-11 and 12-17, while it is more equally distributed in the older age group. This indicates that relatively more children in the age group 18-23 months have lower ICFI score (and therefore less positive practices).

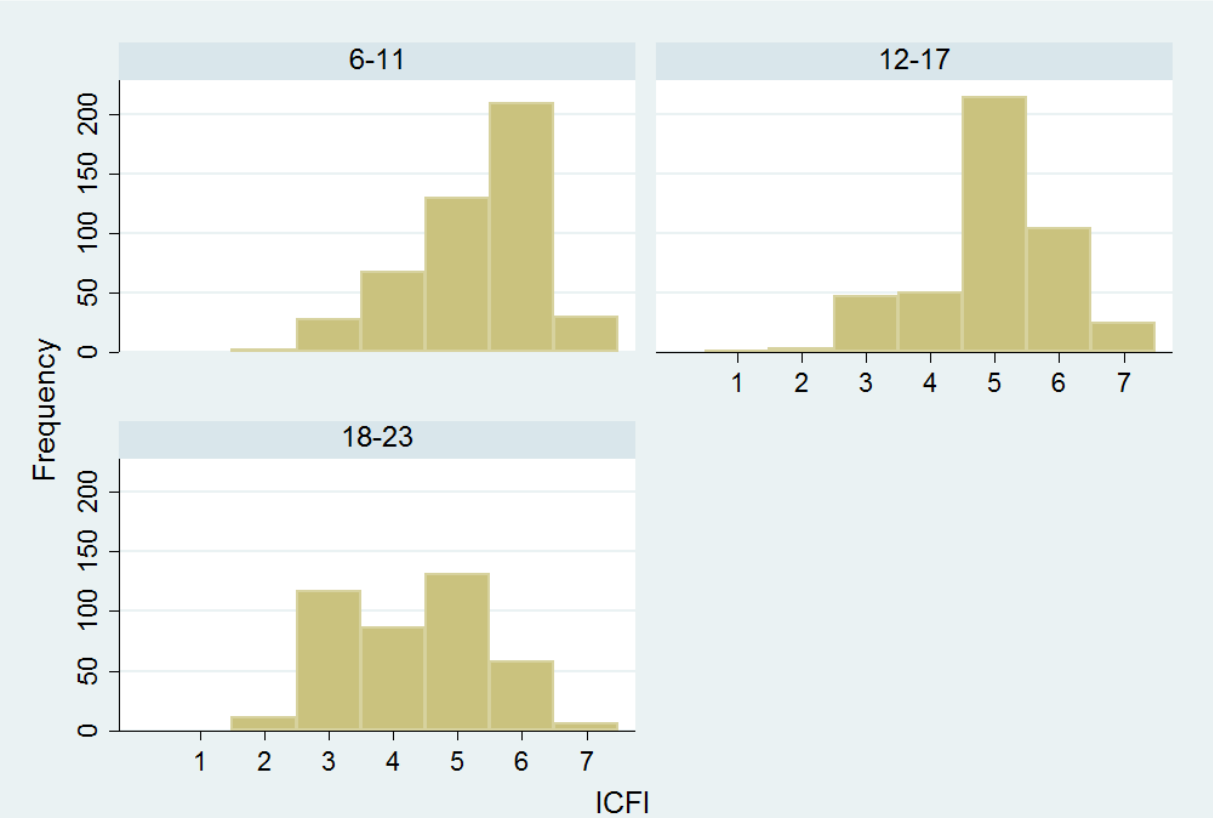

Figure 1: ICFI distribution by age group

Table 8 shows the mean HAZ by ICFI, ICFI components, and by age group.

The mean HAZ was significantly and negatively related to ICFI categories among children aged 12-17 mo., but not in the other age groups. As far as the single breastfeeding component of ICFI is concerned, non-breastfed children exhibited a statistically significant higher HAZ in the age group 6-11, but not in the other groups. Bottle feeding was associated with higher HAZ among children in the age group 18-23. Meal frequency was negatively associated with mean HAZ in the age group 12-17, while diet diversity was positively associated with mean HAZ in the older age group.

Table 8: Distribution and association of HAZ score with ICFI and its components, by age group

Component	Categories	6-11	12-17	18-23
ICFI	Low	-0.95 ± 0.20	-1.51 ± 0.19	-2.05 ± 0.11
	Medium	-1.28 ± 0.13	- 2.14 ± 0.10	-2.32 ± 0.12
	High	-1.36 ± 0.10	- 1.82 ± 0.14	-2.07 ± 0.15
	Pvalue	0.170	0.008	0.230
Breastfeeding	Yes	-1.31 ± 0.07	-1.91 ± 0.34	-2.01 ± 0.11
	No	-0.03 ± 0.56	-1.71 ± 0.08	-2.24 ± 0.10
	Pvalue	0.023	0.563	0.102
Bottle-feeding, %	Yes	-0.68 ± 0.33	-1.46 ± 0.96	-0.71 ± 0.16
	No	-1.26 ± 0.08	-1.90 ± 0.08	-2.13 ± 0.73
	Pvalue	0.082	0.6476	0.0000
Meal Frequency, %	Low (0)	-1.12 ± 0.17	-1.37 ± 0.15	-2.15 ± 0.19
	Medium (1)	-1.35 ± 0.13	-1.96 ± 0.11	-2.19 ± 0.09
	High (2)	- 1.22 ± 0.11	-1.99 ± 0.16	-1.83 ± 0.13
		0.52	0.003	0.082
Diet Diversity, %	Low (0)	-1.47 ± 0.28	-1.60 ± 0.37	-2.66 ± 0.10
	Medium (1)	-1.22 ± 0.08	-1.91 ± 0.92	-2.09 ± 0.08
	High (2)	-1.38 ± 0.24	-1.84 ± 0.18	-1.89 ± 0.13
	Pvalue	0.586	0.696	0.000

Values are means ± SD

5 Discussion and recommendations

This analysis investigates data from the IYCF and anthropometric household survey and describes associations between variables. Given the nature of a cross-sectional survey, it is not possible to infer causality. The results however provide some insights in the current nutritional status in three Tanzanian regions and should be discussed in view of the results from the other baseline surveys conducted by Concern Worldwide.

The regions of Njombe, Mbeya and Iringa are the breadbasket of Tanzania, and have not faced major problems of food availability recently, nor major health crises. This is reflected in the very low wasting prevalence (3.4%) among 0-59 months old children as well as the very low maternal undernutrition. Nevertheless, households' food security remains volatile and the prevalence of stunting is very high (43.2%), which deserves attention in trying to identifying driving factors.

5.1 Factors associated with stunting

This study investigates factors associated to the nutritional status of pre-school children in three regions of the southern highlands in Tanzania. The likelihood of stunting is higher among children in the regions of Njombe and Iringa, compared to Mbeya. The three regions have similar profiles, so that no clear cause can be identified that explains this difference. Factors to further investigate are for example diet habits, cultural practices and HIV prevalence. Children under 2 years of age consume more dairy products in Mbeya than in the other regions (results not shown), which is associated with improved linear growth [38]. The higher HIV/AIDS prevalence in Njombe (15% vs 9% in Iringa and Mbeya) [39] can also have implications on the households' economic status. Yet, a deeper understanding of environmental, economic and cultural factors increasing the risk of stunting in these regions is necessary to better define interventions.

With regard to child characteristics, our analysis confirms that children in their second and third year of life (12-23 and 24-35-month-old) are more likely to be stunted than both younger and older children. This is well-recognised in the literature. Studies have shown that children accumulate growth delay during the first 2 years of life, with stunting peaking around 2 and 3 years, after which they stabilise [15,40]. Furthermore, boys are at higher risk than girls, which also confirms results from sub-Saharan African and Asian countries [41].

The nutritional status of a child is directly related to maternal presence and her reproductive status. Maternal time allocation affects both the child nutritional status (through the time spent caring for the child), and income generation (through labour force) [42]. The net effect may vary by household and by child age. Our study shows that small children are particularly affected by maternal absence, while the results are mixed among older children. Furthermore, in Njombe and Iringa, children of pregnant women, as well as women with recent short birth intervals are more likely to be stunted. Among the older children, those whose mother is breastfeeding have higher odds. This may be due to the fact that older children receive less attention when younger siblings are in the household or about to come. Programmes supporting mothers during pregnancy and lactation can have positive effects not only on the new-born, but also on older siblings. Cost-benefit studies of such interventions should also take this into account. Reproductive health programmes involving men and boys represent an important channel to emphasise men's shared responsibility and active role in pregnancy and childcare [43]. A better understanding of cultural norms defining women's and men's reproductive role in the Tanzanian southern highlands is necessary to design successful programmes. Various activities could contribute

reducing the workload on women: conservation agriculture, shortening distance to drinking water sources, engaging with other family members. For example, appropriate substitute care from adult family members as well as preschool programmes have positive nutritional and developmental effect on children with working mothers [44,45]. Finally, our study supports the evidence on promoting child spacing and family planning, which can reduce maternal burden and has been shown to contribute to a reduction of stunting [46].

It is widely accepted that economic welfare boosts nutritional status. Studies from resource-limited settings show that children from families with greater income and resources tend to have better diets, improved nutritional status and an overall growth-conducive environment [23,47,48]. Our study contributes to this evidence by showing that higher household diet diversity score is associated with lower odds for stunting among 6-23-month-old children. The number of food groups consumed in a household is commonly used as a proxy for the socio-economic level, as it reflects the economic access to a variety of foods [32,49]. The interpretation of the relation between HDDS and stunting is complicated by the fact that richer families usually have better access to health care and improved environmental health, therefore pointing to a broader relation between poverty and stunting, and not between food variety at the household level and stunting. Cultural food practices may have a strong mediating influence on a child nutrition status regardless of the family economic conditions. Therefore further operational research to unravel the pathways should be undertaken.

Access to improved water source and to a functioning hand washing station protects against stunting, particularly among older children. These two public health interventions are likely to reduce the transmission of diarrhoeal diseases and the risk of tropical enteropathy [50,51], which are both associated with reduced linear growth. Since 43% of the Tanzania households still do not have access to improved water source [29], strengthening strategies to increase the provision of water and sanitation interventions is crucial for the health of preschool children.

Surprisingly, the production of vitamin A rich food was found to increase the odds of stunting, instead of reducing it. It should be investigated further whether producing vitamin A food substitutes the production (and consumption) of animal based food, which may have a greater impact on child growth.

None of the IYCF indicators was associated with linear growth, despite evidence from multi-country studies which indicate that diverse [52,53] and adequate diet, as well as solid food consumption [54] reduce the risk of stunting. In the same studies, no association is found between meal frequency and

linear growth, as in our analysis. Very few children (<1%) in our study met the definition of adequate diet, unlike reported in the National Nutrition Survey where 7.3%, 5.3% and 23.9% of the children in Iringa, Mbeya and Njombe received MAD. Our results are not comparable with the last DHS, where minimum dietary diversity was defined as 3 or more food groups (instead of 4 as defined by WHO).

Receiving nutritional advice was not associated with better nutritional status among the survey respondents. Knowledge and awareness is not always translated into appropriate practice, as other factors such as the social context also shapes individual's behaviour. Also, the use of health education is rarely sufficient on its own [55]. Finally, peer-to-peer counselling may be more effective than the one-way transfer of information through campaigns, media, or health officers. The barrier analysis indicated that awareness messages should be addressed to a wider public, and not focus only on caregivers. In fact, also the other parent as well as grandmothers influence child feeding practices by supporting or rejecting selected practices.

This analysis has certain limitations. First, the cross-sectional study design does not allow to investigate causation, but only association. Second, information on additional explanatory factors such as maternal education, household size and vaccination coverage were not collected, despite the importance recognised to them in the literature. Finally, it was not possible to investigate the extent to which HIV/AIDS influences stunting in this population. Given the complexity and sensitivity around HIV status, data on HIV prevalence were not collected.

5.2 Focus on IYCF

Our results indicate that overall IYCF guidelines are poorly followed in the Tanzanian southern highlands. In our sample, only four in ten children are exclusively breastfed in the first 6 months after birth, one in 4 children eats the minimum number of times per day, and sufficient diet diversity is experienced by only one in six children.

Disaggregating the results by age pointed to the fact that overall quality of feeding practices among older children is lower than among younger children. Both frequency and diet diversity do not increase with age, despite the nutritional intake required increases with age. This may be explained by the perception that younger children may be more vulnerable than older ones.

At the same time however, we found only diet diversity to be positively associated with mean HAZ (not with stunting as discussed above). This is in line with the results from other studies [52,56].

The negative associations found between HAZ and breastfeeding, bottle feeding and meal frequency can be possibly explained with "reverse causality", as already identified by other authors [56,57]. The hypothesis is that mothers tend to prolong breastfeeding and increase the number of meals when the child is malnourished. Both behaviours could be also linked to household wealth (food availability) and occurrence of diseases. Prospective studies should be conducted to investigate further the direction of the relationship.

5.3 Conclusion and suggestions

In conclusion, our analysis confirms that stunting remains a public health problem in the southern highlands region in Tanzania. Based on this analysis, we have identified a number of suggestions, both at operational and policy level.

Operational:

First, we would advise to collect information on the household roster such as detailed composition of the household and the relation between the respondent and each measured child. In addition, other key and measurable information should be incorporated, such as maternal education, household economic status and limited but critical information on child health (especially vaccination status).

Second, design the data collection process as panel would allow building up a very strong evidence base for measuring the full impact of the interventions. Panel data will allow a better understanding of the effect of IYCF on stunting in older children. The conclusions will be significantly strengthened since the panel approach will measure the same children and interview the same households during the endline survey.

Policy:

Three main areas should be addressed:

First, interventions aiming to improve household wealth and sanitation conditions should be expanded.

Second, family planning programmes as well as supporting activities for mothers during pregnancy and lactation should be strengthened. These should focus on gender roles within the household and around childcare.

Third, promotion of IYCF practices among caregiver and extended family.

6 Annexes

6.1 Annex 1: Definition and categorisation of new variables

Variable	Definition	Type	Values
Exclusive breastfeeding	Child aged 0 to 5 month who is fed only breast milk. Status based on simultaneous negative answer to questions on the intake of liquid and solid foods.	Categorical	0 if not exclusively breastfed; 1 if exclusively breastfed
Individual Diet Diversity Score (IDDS) [32]	Number of food groups consumed by the child 6 to 23 months of age in the 24 hours before the survey.	Continuous	From 0 to 7
Minimum Diet Diversity (MDD) [33]	Proportion of children 6 to 23 months of age eating from 4 or more food groups	Categorical	0 if < 4 groups 1 if >= 4 groups
Minimum Meal Frequency (MMF) [33]	Proportion of children receiving solid, semi-solid or soft food (but also including milk feed for non-breastfed children) the minimum number of times according to their age and breastfeeding status. Minimum is defined as: – 2 times for breastfed infants 6 to 8 month old; – 3 times for breastfed children 9 to 23 month old; – 4 times for non-breastfed children 6 to 23 month old.	Categorical	0 if MMF not reached; 1 if MMF reached
Minimum Adequate Diet (MAD) [33]	Proportion of children 6 to 23 months of age who reach both MMF and MDD. It is calculated separately for breastfed and non-breastfed children. For breastfed children, it corresponds to the children who reach both MDD and MMF. For non-breastfed children, MAD is based on a 6-food groups MDD and requires also 2 separate milk feeds.	Categorical	0 if MAD not reached; 1 if MAD reached
Infant and child feeding index (ICFI)	Scoring index that gives points for positive practices for children 6 to 23 months of age. It includes: breastfeeding, bottle use, diet	Continuous	From 0 to 7

	diversity and meal frequency. Adapted from [34].		
Categorised ICFI		Categorical	Low: ICFI>=1&ICFI<=4 Middle: ICFI==5 High: ICFI>=6
Age appropriate feeding practices	Composite index summarising practices of different age groups for children 0 to 23 months of age. It is based on exclusive breastfeeding, frequency of meals, food diversity. Adapted from [35]	Categorical	0 not good 1 good
Household Diet Diversity Score (HDDS) [32]	Number of food groups consumed by HH member in the 24 hours before the survey.	Continuous	From 0 to 12
Categorised HDDS	Categorisation defined by the authors, as no standard thresholds exist.	Categorical	0-4 5-8 9-12
Farm Production Diversity Score (FPDS)	Number of food groups produced by the HH in the last 3 months.	Continuous	From 0 to 12
Categorised FPDS	Categorisation defined by the authors, as no standard thresholds exist.	Categorical	0 (no production) 1-2 3-5 6-12
Maternal malnutrition	Below 210 mm for non PLW; below 230 mm for PLW [58] [and personal communication with Mark Myatt]	Categorical	0 not malnourished 1 malnourished
Source of drinking water	Improved = piped water, protected well, protected spring, bottled water. Otherwise = unimproved.	Categorical	0 unimproved 1 improved
Hand washing knowledge	Good = if 3 or more of the options replied; Satisfactory = if two of the options replied; poor= if one or none of the options replied, + don't know	Categorical	2 Good 1 Satisfactory 0 poor
Hand washing station	Functional = there is a station + water + soap or ash; non-functional if otherwise	Categorical	0 non functional 1 functional
Health seeking behaviour	Those who sought medical care in case of illness of the child	Categorical	0 medical care not sought 1 medical care sought

6.2 Annex 2: Result tables

6.2.1 Descriptive analysis

Table 9: Descriptive statistics of the sample – child characteristics by age group (0-23, 24-59, 0-59)

	0-23		24-59		0-59	
Child characteristics	**N**	**% or *[mean (SD)]**	**N**	**% or *[mean (SD)]**	**N**	**% or *[mean (SD)]**
Nutritional status						
Wasting	1784	3.4	1896	1.3	3,680	2.2
Weight for Height		-0.29 (1.36)		0.23 (1.08)		0.26 (1.23)
Stunting	1781	35.3	1895	49.5	3,676	43.2
Height for Age		-1.49 (1.64)		-2.02 (1.36)		-1.76 (1.53)
Underweight	1789	12.5	1903	14.9	3,692	13.8
Weight for Age		-0.6 (1.3)		0.99 (1.03)		-0.8 (1.2)
Age (in months)	1791	11.4 (6.7)*	**1904**	38.4 (10.3) *	3695	25.3 (16.1)*
0-11		49.1				22.9
12-23		50.9				23.7
24-35				43.2		23.0
36-47				32.4		17.3
48-59				24.4		13.0
Sex	1791		**1904**		3695	
Male		52.1		50.3		50.8
Female		47.9		49.7		49.2
Child living with	1766					
Both parents		83.6				
Mother only		14.3				
Other guardians		2.1				

Child staying with when mother go out	269					
Grand parents		21.3				
Other adult relatives		25.0				
Siblings younger than 15		30.0				
Siblings older than 15		12.5				
Father		5.8				
Nobody child is alone		2.3				
Others		3.1				
Exclusive breastfeeding (0-5 months)	431					
Yes		35.8				
No		64.3				
Continued breastfeeding at age 1 (12-15 months)	316					
Yes		91.5				
No		8.5				
Timely introduction of foods	1766					
Still exclusive breastfeed		14.0				
Younger than 6 months		52.3				
6 months or older		31.8				
Don't know		1.9				
Individual Diet Diversity Score (6-23 only)	1337	2.3 (1.1)*				
Less than 4 groups		87.0				
4 or more groups		13.0				
Consumption of animal source food (6-23 only)	**1338**					
At least one food		32.1				
No		67.9				
Consumption of vit-A rich fruits & veg (6-23 only)	**1337**					
Yes		13.8				
No		86.2				
Consumption of pulse/legumes/nuts (6-23 only)	**1337**					

Yes		37.2				
No		62.8				
Snack between the meals (6-23 only)	**1330**					
No snack		80.4				
One snack		12.0				
Two snack		7.6				
Minimum Diet Diversity (6-23 only)	1360					
Yes		15.2				
No		84.8				
Minimum Meal Frequency (6-23 only)	1336					
Yes		26.8				
No		73.2				
Minimum Adequate Diet (6-23 only)	1337					
Yes		0.8				
No		99.2				
Infant and Child Feeding Index (6-23 only)	1322					
Optimal (7 points)		3.9				
Suboptimal (less than 7 points)		96.1				
Age-appropriate IYCF	1753					
Good		11.9				
Not good		88.1				
Illnesses	1791					
No illness		60.1				
One illness		22.3				
Two or three illnesses		17.6				
Type of illnesses	691					
Diarrhoea		45.8				
Fever		39.4				
ARI		64.8				

Health seeking behaviour	648					
Good		70.5				
No		29.5				
Vitamin A supplementation received	1479					
Yes		72.8				
No		27.2				
Child dewormed	1459					
Yes		45.3				
No		54.7				

* mean (SD)

Table 10: Descriptive statistics of the sample - maternal characteristics by age group (0-23, 24-59, 0-59)

	0-23		**24-59**		**0-59**	
Mothers characteristics	**N**	**% or *[mean(SD)]**	**N**	**% or *[mean(SD)]**	**N**	**% or *[mean(SD)]**
Birth in the last 5 years	1787		1902		3689	
1 child		74.6		85.2		80.3
2 + children		25.4		14.8		19.7
Currently pregnant	1776		**1856**		3695	
Yes		2.7		10.2		6.5
No		97.3		89.8		91.3
Current breastfeeding	1791		**1904**		3695	
Yes		79.3		92.3		41.0
No		20.7		7.7		59.0
MUAC (in cm)	1734	27.6 (3.2)*	**1694**	28.1 (3.4)*	3428	27.8 (3.3)*
malnourished (<210 or 230 if PLW)		2.5		0.9		1.7
non-malnourished		97.5		99.1		98.3

Hand washing knowledge	1787		**1902**		3689	
Poor		15.6		17.8		16.7
Satisfactory		44.1		51.9		48.2
Good		40.3		30.3		35.0
Take care of garden	570		638		1208	
Myself		52.7		67.8		60.7
Partner		13.4		9.9		11.6
Jointly		22.5		16.5		19.4
Older children		2.5		1.2		1.8
Parents/parents in-laws		4.6		2.3		3.3
Other family members		3.6		1.8		2.6
Others		0.7		0.5		0.6
Work load during pregnancy	1344					
Less		64.4				
The same		33.7				
More		19				
Amount of food during pregnancy	1336					
Less		43.6				
The same		39.9				
More		16.6				
Food diversity during pregnancy	1338					
Fewer type		35.6				
The same		46.3				
More types		18.2				
Husband support during pregnancy	1392					
Yes		74.1				
No		25.9				
Advice on C&M nutrition	1381					
Yes		41.4				

No		58.6				
Iron supplements	1392					
Yes		63.7				
No		36.3				
Alternative care when mother goes out	269		724		993	
Relatives older than 15		64.6		50.1		54.2
Relatives younger than 15		30.0		38.0		35.8
Child left alone		2.3		6.1		5.0
Others		3.1		5.7		5.0
Food left for child when mother go out	269		724		993	
Yes		57.9	65.6			63.4
No		42.1	34.4			36.6
Hours away from home	1791		**1904**		3695	
No		48.0		42.6		45.1
1-3 hours		21.3		20.5		20.9
4-7 hours		20.9		22.4		21.6
8-24 hours		9.8		14.6		12.4
Decision making to use money	260		288		548	
Myself		42.1		50.1		46.3
Partner		24.7		15.3		19.9
Jointly		33.2		34.5		33.9
Decision making to feed	1392		135		1527	
Caregiver		75.0		53.0		73.0
Partner		6.6		12.8		7.2
Jointly		13.2		31.7		14.9
Others		5.2		2.5		4.9

Table 11: Descriptive statistics of the sample - household characteristics by age group (0-23, 24-59, 0-59)

	0-23		24-59		0-59	
Household Characteristics	**N**	**% or *[mean(SD)]**	**N**	**% or *[mean(SD)]**	**N**	**% or *[mean(SD)]**
Source of drinking water	1787		**1902**		3689	
Improved		68.7		70.7		69.7
Not improved		31.3		29.3		30.3
Hand washing station	1791		**1904**		3695	
Functional		6.3		7.9		7.2
No or not functional		93.7		92.1		92.8
HDDS	1780	5.0 (1.8)*	**1894**	5.0 (1.8)*	3674	5.0 (1.8)*
0-4		39.1		36.7		37.8
5-8		58.1		59.5		58.9
9-12		2.8		3.8		3.3
FPDS	1779	3.0 (2.1)*	**1886**	3.5 (2.3)*	3665	3.3 (2.2)*
No		14.1		11.6		12.8
1-2		29.4		24.1		26.6
3-5		41.8		42.3		42.0
6-12		14.8		22.0		18.6
Home/ Kitchen Garden	1791		**1904**		3695	
Yes		26.9		26.6		26.8
No		73.1		73.4		73.2
Frequency of buying fresh food	1787		**1902**		3689	
Daily		43.5		47.9		45.8
2-3 times/week		35.6		30.7		33.0
Once a week		10.6		11.1		10.9
Less often		10.4		10.2		10.3
Garden production	562		626		1188	
Own consumption		72.5		74.9		73.8

Sell		7.8		10.2		9.1
Consumption and sell		19.8		14.9		17.2
Production of animal source food	1791		**1904**		3695	
At least one food		60.1		65.6		63.0
No		39.9		34.4		37.0
Consumption of animal source food	1791		**1904**		3695	
At least one food		49.6		48.8		49.2
No		50.4		51.2		50.8
Production of vitamin A rich	1791		**1904**		3695	
At least one food		39.3		47.2		43.5
No		60.7		52.8		56.5
Consumption of vitamin A rich	1791		**1904**		3695	
At least one food		80.4		83.5		82.0
No		19.6		16.5		18.0
Use of iodised salt	1753		**1871**		3624	
Yes		79.5		79.2		79.4
No		20.5		20.8		20.6

Table 12: Descriptive statistics of the sample - contextual variables by age group (0-23, 24-59, 0-59)

	0-23		**24-59**		**0-59**	
Contextual variables	**n**	**%**		**%**	**n**	**%**
Place of residence	1791		**1904**		3695	
Urban		20.3		20.5		20.4
Rural		79.7		79.5		79.6
Region	1791		**1904**		3695	
Mbeya		62.3		67.4		65.0
Njombe		15.7		13.4		14.5
Iringa		22.1		19.2		20.5

6.2.2 Bivariate and multivariate analysis- children 6-23 month old

Table 13: Bivariate and multivariate logistic regression results, 6 to 23 month old

VARIABLES Observations	Overall Bivariate	Overall Multivariate	Mbeya Bivariate	Mbeya Multivariate	Njombe Bivariate	Njombe Multivariate	Iringa Bivariate	Iringa Multivariate
Male Sex	2.151***	2.170***	2.346***	2.90***	1.671***	2.13***	2.038***	2.45***
	(1.645 - 2.812)	(1.522 - 3.094)	(1.572 - 3.499)	(1.76 - 4.80)	(1.153 - 2.422)	(1.27 - 3.60)	(1.407 - 2.951)	(1.44 - 4.16)
Age								
6-11	1	1	1	1	1	1	1	1
12-23 month old	2.701***	3.907***	2.730***	4.63***	2.923***	3.04***	2.632***	4.74***
	(2.015 - 3.620)	(2.494 - 6.119)	(1.751 - 4.256)	(2.47 - 8.67)	(1.968 - 4.342)	(1.68 - 5.50)	(1.752 - 3.952)	(2.40 - 9.37)
Receiving Deworming treatment	1.121	0.643**	0.868	0.53**	1.282	0.83	1.890***	1.02
	(0.853 - 1.472)	(0.414 - 0.999)	(0.578 - 1.304)	(0.30 - 0.93)	(0.876 - 1.875)	(0.43 - 1.59)	(1.282 - 2.788)	(0.53 - 1.96)
Last pregnancy same food type	1.150	1.295	1.128		0.688	0.61	1.789**	1.92
	(0.814 - 1.623)	(0.776 - 2.162)	(0.648 - 1.961)		(0.433 - 1.092)	(0.31 - 1.22)	(1.125 - 2.844)	(0.83 - 4.46)
Last pregnancy more food type	1.054	0.871	1.047		0.898	0.90	1.097	0.71
	(0.689 - 1.613)	(0.488 - 1.554)	(0.465 - 2.360)		(0.519 - 1.553)	(0.40 - 2.05)	(0.639 - 1.883)	(0.30 - 1.66)
Last pregnancy husband support	0.817	0.947	0.911		0.612**	0.95	0.701	0.77
	(0.576 - 1.159)	(0.635 - 1.413)	(0.522 - 1.589)		(0.376 - 0.995)	(0.51 - 1.79)	(0.441 - 1.112)	(0.40 - 1.46)
More than one birth	0.925	1.053	0.713	0.75	1.356	1.61	1.423*	2.02**
in the last 2 years	(0.678 - 1.262)	(0.699 - 1.584)	(0.441 - 1.151)	(0.41 - 1.38)	(0.844 - 2.180)	(0.78 - 3.32)	(0.948 - 2.136)	(1.11 - 3.66)
Mother currently pregnant	1.469	1.930	0.984	0.57	2.982**	4.26**	1.806	6.64**
	(0.699 - 3.087)	(0.797 - 4.673)	(0.273 - 3.540)	(0.13 - 2.47)	(1.045 - 8.508)	(1.08 - 16.87)	(0.675 - 4.829)	(1.23 - 35.66)
Handwashing knowledge								
Poor	1	1	1	1	1	1	1	1
Satisfactory	0.929	1.155	0.855	1.19	0.780	1.02	1.369	3.10***
	(0.638 - 1.353)	(0.690 - 1.934)	(0.482 - 1.516)	(0.56 - 2.53)	(0.484 - 1.259)	(0.52 - 2.03)	(0.792 - 2.368)	(1.33 - 7.24)

Good	0.781	0.958	0.765	1.00	0.980	0.95	0.812	1.13
	(0.530 - 1.150)	(0.547 - 1.675)	(0.431 - 1.357)	(0.46 - 2.19)	(0.583 - 1.647)	(0.45 - 2.00)	(0.460 - 1.433)	(0.47 - 2.71)
Improved Water source	0.794	0.784	0.806	0.93	0.952	1.13	0.479***	0.57
	(0.593 - 1.063)	(0.506 - 1.215)	(0.541 - 1.200)	(0.53 - 1.61)	(0.601 - 1.507)	(0.59 - 2.18)	(0.303 - 0.757)	(0.28 - 1.15)
Animal food production	0.975	1.103	1.000	1.29	0.667**	0.50**	1.151	1.59
	(0.745 - 1.275)	(0.690 - 1.763)	(0.673 - 1.486)	(0.65 - 2.56)	(0.455 - 0.976)	(0.26 - 0.95)	(0.794 - 1.669)	(0.77 - 3.32)
Vitamin-A-rich food production	1.428***	1.707**	1.430*	1.79*	1.587**	1.69	1.299	1.33
	(1.091 - 1.869)	(1.055 - 2.760)	(0.960 - 2.130)	(0.90 - 3.57)	(1.088 - 2.315)	(0.88 - 3.25)	(0.898 - 1.878)	(0.66 - 2.68)
Use Iodised salt	0.717**	0.865	0.849	0.90	0.772	0.75	0.535***	0.41***
	(0.526 - 0.977)	(0.559 - 1.338)	(0.500 - 1.441)	(0.45 - 1.83)	(0.527 - 1.132)	(0.43 - 1.31)	(0.343 - 0.836)	(0.21 - 0.79)
HDDS								
1-4	1	1	1	1	1	1	1	1
5-8	0.657***	0.610**	0.658**	0.63	0.796	0.86	0.610***	0.73
	(0.502 - 0.861)	(0.406 - 0.918)	(0.441 - 0.984)	(0.36 - 1.09)	(0.547 - 1.159)	(0.46 - 1.62)	(0.420 - 0.887)	(0.40 - 1.32)
9-12	0.247***	0.145***	0.203**	0.14**	0.850	1.23	0.102**	0.14
	(0.093 - 0.655)	(0.034 - 0.527)	(0.0437 - 0.947)	(0.02 - 0.96)	(0.277 - 2.606)	(0.16 - 9.41)	(0.0127 - 0.824)	(0.01 - 1.78)
Home garden	0.949	0.578**	0.690	0.51*	1.058	1.03	1.374*	1.01
	(0.716 - 1.257)	(0.375 - 0.890)	(0.421 - 1.133)	(0.25 - 1.04)	(0.719 - 1.557)	(0.57 - 1.87)	(0.947 - 1.993)	(0.53 - 1.91)
Frequency buying fresh food								
Daily	1	1	1	1	1	1	1	1
2-3 times/week	0.928	0.913	0.764	0.90	1.201	0.80	1.336	2.19**
	(0.687 - 1.253)	(0.589 - 1.417)	(0.492 - 1.186)	(0.51 - 1.59)	(0.781 - 1.847)	(0.40 - 1.63)	(0.880 - 2.028)	(1.14 - 4.23)
Once a week	1.171	0.842	1.249	1.39	1.150	0.61	0.980	1.47
	(0.756 - 1.814)	(0.454 - 1.560)	(0.632 - 2.469)	(0.55 - 3.49)	(0.660 - 2.004)	(0.28 - 1.36)	(0.520 - 1.850)	(0.53 - 4.05)
Less often	1.185	0.784	0.961	0.70	2.281**	2.00	1.280	1.11
	(0.758 - 1.854)	(0.426 - 1.445)	(0.478 - 1.929)	(0.27 - 1.76)	(1.185 - 4.389)	(0.76 - 5.28)	(0.709 - 2.310)	(0.41 - 2.99)
Mother, hours away								
Zero	1	1	1	1	1	1	1	1

1-3 hours	0.847	1.004	0.793	0.96	0.783	0.80	1.226	1.94*
	(0.593 - 1.210)	(0.635 - 1.587)	(0.477 - 1.319)	(0.53 - 1.76)	(0.461 - 1.330)	(0.39 - 1.62)	(0.741 - 2.030)	(0.92 - 4.07)
4-7 hours	1.635***	1.928***	1.896**	2.25**	1.063	0.99	1.420	1.09
	(1.168 - 2.290)	(1.210 - 3.072)	(1.144 - 3.144)	(1.20 - 4.19)	(0.668 - 1.692)	(0.53 - 1.85)	(0.895 - 2.253)	(0.54 - 2.20)
8-24 hours	0.825	1.072	0.793	1.00	0.581*	0.62	1.173	1.31
	(0.528 - 1.289)	(0.580 - 1.982)	(0.393 - 1.603)	(0.42 - 2.39)	(0.335 - 1.009)	(0.29 - 1.35)	(0.607 - 2.268)	(0.52 - 3.31)
Urban Residence	0.682**	0.804	0.650	0.59	0.975	1.17	0.497***	0.58
	(0.487 - 0.954)	(0.477 - 1.357)	(0.379 - 1.114)	(0.27 - 1.26)	(0.640 - 1.485)	(0.60 - 2.29)	(0.304 - 0.810)	(0.26 - 1.33)
Region								
Mbeya	1	1						
Njombe	1.343**	1.765**						
	(1.028 - 1.755)	(1.114 - 2.797)						
Iringa	1.189	1.590**						
	(0.911 - 1.552)	(1.055 - 2.396)						
Achieved MDD	1.051	1.043	1.309	2.37*	0.672	0.44	0.690	0.70
	(0.721 - 1.531)	(0.472 - 2.305)	(0.781 - 2.193)	(0.89 - 6.34)	(0.384 - 1.175)	(0.12 - 1.60)	(0.394 - 1.209)	(0.22 - 2.26)
Child consumption: Animal food	0.983	1.127	0.999	1.08	0.986	2.10*	1.044	0.84
	(0.736 - 1.313)	(0.671 - 1.892)	(0.663 - 1.506)	(0.57 - 2.03)	(0.643 - 1.512)	(0.90 - 4.88)	(0.691 - 1.576)	(0.38 - 1.84)
Child consumption: VitA rich food	0.878	0.872	0.835	0.52	0.903	1.40	1.125	1.54
	(0.591 - 1.305)	(0.443 - 1.717)	(0.479 - 1.454)	(0.20 - 1.36)	(0.513 - 1.591)	(0.50 - 3.90)	(0.628 - 2.015)	(0.60 - 3.98)
Child consumption: beans etc	1.067	0.860	1.235	1.08	0.816	0.58*	0.841	0.88
	(0.811 - 1.404)	(0.568 - 1.302)	(0.825 - 1.848)	(0.62 - 1.87)	(0.558 - 1.192)	(0.33 - 1.03)	(0.572 - 1.237)	(0.47 - 1.65)
Child morbidity								
No illness	1	1	1	1	1	1	1	1
One illness	0.942	0.992	0.810	0.91	1.378	1.40	1.188	1.02
	(0.682 - 1.301)	(0.660 - 1.490)	(0.502 - 1.309)	(0.50 - 1.66)	(0.871 - 2.181)	(0.77 - 2.56)	(0.760 - 1.857)	(0.54 - 1.91)
Two or three illnesses	0.875	0.984	0.777	0.79	0.917	0.63	1.504	0.74
	(0.617 - 1.240)	(0.592 - 1.634)	(0.480 - 1.258)	(0.42 - 1.46)	(0.536 - 1.570)	(0.29 - 1.37)	(0.894 - 2.530)	(0.35 - 1.57)

Received Vitamin A dose	1.203	1.140	1.076	0.91	1.227	1.39	1.636*	1.07
	(0.840 - 1.725)	(0.686 - 1.895)	(0.660 - 1.756)	(0.47 - 1.76)	(0.740 - 2.034)	(0.64 - 2.99)	(0.919 - 2.914)	(0.44 - 2.57)
Maternal malnutrition	1.206	0.927	0.748		0.777	0.55	2.318	3.56*
	(0.531 - 2.738)	(0.354 - 2.430)	(0.135 - 4.134)		(0.243 - 2.487)	(0.11 - 2.80)	(0.842 - 6.380)	(0.95 - 13.28)
Decision to feed the child	0.811	0.886	0.812		0.880	1.02	0.830	0.79
(others)	(0.568 - 1.159)	(0.565 - 1.391)	(0.463 - 1.425)		(0.522 - 1.485)	(0.50 - 2.08)	(0.528 - 1.305)	(0.41 - 1.51)
Receiving Advice on MC nutrition	1.061	1.064	1.111		0.809	0.81	1.035	0.96
	(0.785 - 1.436)	(0.741 - 1.529)	(0.660 - 1.868)		(0.540 - 1.211)	(0.47 - 1.39)	(0.700 - 1.531)	(0.57 - 1.63)
Last pregnancy – food amount								
less	1	1	1	1	1	1	1	1
The same	0.951	0.728	0.811		0.826	0.94	1.297	1.09
	(0.680 - 1.331)	(0.441 - 1.203)	(0.458 - 1.436)		(0.527 - 1.296)	(0.48 - 1.84)	(0.835 - 2.014)	(0.48 - 2.47)
More	1.223	1.314	1.629		0.648	0.54	1.052	1.24
	(0.782 - 1.912)	(0.721 - 2.395)	(0.774 - 3.428)		(0.356 - 1.178)	(0.23 - 1.28)	(0.588 - 1.881)	(0.50 - 3.07)
Mother Currently breastfeeding	0.830	0.849	0.798	1.20	0.813	0.81	0.869	1.22
	(0.612 - 1.125)	(0.543 - 1.329)	(0.520 - 1.223)	(0.66 - 2.16)	(0.517 - 1.278)	(0.39 - 1.68)	(0.563 - 1.341)	(0.61 - 2.44)
MMF	0.948	1.449*	0.799	0.88	1.147	1.53	1.024	1.16
	(0.711 - 1.265)	(0.965 - 2.176)	(0.494 - 1.292)	(0.49 - 1.60)	(0.784 - 1.677)	(0.87 - 2.67)	(0.693 - 1.514)	(0.64 - 2.10)
Functioning Hand washing	0.689	1.537	0.411	1.04	1.297	1.09	0.852	1.54
Station	(0.407 - 1.168)	(0.728 - 3.246)	(0.133 - 1.269)	(0.27 - 4.05)	(0.602 - 2.791)	(0.36 - 3.32)	(0.453 - 1.600)	(0.57 - 4.15)
HH consumption: Animal food	0.806	0.828	0.896	1.02	0.685*	0.79	0.747	1.15
	(0.619 - 1.049)	(0.529 - 1.295)	(0.607 - 1.324)	(0.56 - 1.85)	(0.465 - 1.007)	(0.40 - 1.57)	(0.518 - 1.078)	(0.59 - 2.22)
Farm production diversity score								
NO	1	1	1	1	1	1	1	1
1-2	0.982	0.668	1	0.76	0.876	1.29	0.961	0.40*
	(0.635 - 1.520)	(0.346 - 1.289)	(0.533 - 1.875)	(0.33 - 1.76)	(0.451 - 1.700)	(0.46 - 3.63)	(0.533 - 1.732)	(0.15 - 1.03)
3-5	1.049	0.635	0.984	0.56	1.087	1.67	1.083	0.36*
	(0.692 - 1.591)	(0.300 - 1.343)	(0.537 - 1.805)	(0.20 - 1.55)	(0.582 - 2.029)	(0.51 - 5.50)	(0.616 - 1.902)	(0.12 - 1.08)

6-12	1.023	0.711	1.067	0.63	0.862	1.28	1.052	0.45
	(0.613 - 1.708)	(0.265 - 1.904)	(0.537 - 2.121)	(0.17 - 2.26)	(0.392 - 1.895)	(0.29 - 5.64)	(0.475 - 2.329)	(0.10 - 2.05)
HH consumption: Vitamin A	0.914	1.080	0.910	1.05	0.931	0.87	0.888	0.83
	(0.656 - 1.273)	(0.675 - 1.728)	(0.565 - 1.465)	(0.58 - 1.90)	(0.589 - 1.471)	(0.45 - 1.66)	(0.549 - 1.435)	(0.39 - 1.74)

6.2.3 Bivariate and multivariate analysis- children 24-59 month old

Table 14: Bivariate and Multivariate logistic regression results, children 24-59 months

VARIABLES	Overall Univariate	Overall Multivariate	Mbeya Univariate	Mbeya Multi	Njombe Univariate	Njombe Multivariate	Iringa Univariate	Iringa Multivariate
Age								
24-35	1	1	1	1	1	1	1	1
36-47	0.73**	1.28**	0.70**	1.22	0.68**	1.40*	0.87	1.23
	(0.57 - 0.94)	(1.00 - 1.64)	(0.49 - 1.00)	(0.85 - 1.75)	(0.47 - 0.99)	(0.96 - 2.04)	(0.61 - 1.24)	(0.85 - 1.77)
48-59	0.59***	0.71**	0.52***	0.69*	0.64**	0.68*	0.86	0.77
	(0.44 - 0.78)	(0.54 - 0.95)	(0.35 - 0.77)	(0.45 - 1.05)	(0.43 - 0.97)	(0.44 - 1.06)	(0.57 - 1.29)	(0.51 - 1.16)
Male sex	1.30**	0.60***	1.33*	0.53***	1.37*	0.61**	1.18	0.74
	(1.04 - 1.61)	(0.44 - 0.83)	(0.98 - 1.81)	(0.33 - 0.85)	(0.99 - 1.89)	(0.37 - 0.98)	(0.86 - 1.62)	(0.46 - 1.21)
Maternal malnutrition	2.36	2.04	1.99	3.16			2.01	1.20
	(0.63 - 8.83)	(0.48 - 8.66)	(0.33 - 12.01)	(0.39 - 25.67)			(0.36 - 11.05)	(0.20 - 7.30)
2+ birth in the last 5 y.	1.34*	1.12	1.47*	1.07	1.11	1.06	1.16	1.02
	(0.98 - 1.82)	(0.76 - 1.66)	(0.95 - 2.26)	(0.60 - 1.91)	(0.68 - 1.82)	(0.52 - 2.15)	(0.76 - 1.76)	(0.58 - 1.79)
Mother currently breastfeeding	1.79***	1.97***	1.83*	2.82**	1.60	1.64	1.65*	1.57
	(1.20 - 2.68)	(1.18 - 3.29)	(0.99 - 3.39)	(1.23 - 6.47)	(0.89 - 2.88)	(0.72 - 3.71)	(0.98 - 2.79)	(0.79 - 3.13)
Mother currently pregnant	1.08	1.16	1.04	1.05	2.28**	2.81**	1.19	1.25
	(0.74 - 1.58)	(0.76 - 1.75)	(0.64 - 1.71)	(0.59 - 1.86)	(1.05 - 4.93)	(1.20 - 6.60)	(0.69 - 2.07)	(0.66 - 2.35)
Handwashing knowledge								
Poor	1	1	1	1	1	1	1	1
Satisfactory	0.83	0.92	0.81	0.94	0.93	0.78	0.81	0.80
	(0.62 - 1.12)	(0.66 - 1.29)	(0.53 - 1.24)	(0.56 - 1.57)	(0.62 - 1.39)	(0.48 - 1.26)	(0.51 - 1.28)	(0.47 - 1.36)
Good	0.88	0.91	1.03	1.02	0.91	0.86	0.55**	0.47**
	(0.63 - 1.22)	(0.62 - 1.32)	(0.65 - 1.62)	(0.59 - 1.77)	(0.56 - 1.49)	(0.48 - 1.55)	(0.34 - 0.90)	(0.26 - 0.85)
Improved Water source	0.86	0.70**	0.77	0.58***	1.56**	1.53*	0.69*	0.63**
	(0.67 - 1.10)	(0.52 - 0.93)	(0.56 - 1.07)	(0.39 - 0.87)	(1.06 - 2.29)	(0.97 - 2.42)	(0.48 - 1.01)	(0.40 - 0.99)
Functioning	0.73	0.63**	0.63	0.43**	1.16	1.13	0.76	1.02

Handwashing station	(0.49 - 1.07)	(0.40 - 0.98)	(0.32 - 1.21)	(0.18 - 0.99)	(0.55 - 2.44)	(0.46 - 2.77)	(0.49 - 1.18)	(0.59 - 1.76)
Animal food HH consumption	0.67*** (0.54 - 0.84)	0.76* (0.58 - 1.01)	0.63*** (0.46 - 0.86)	0.63** (0.42 - 0.94)	0.88 (0.63 - 1.23)	1.23 (0.78 - 1.94)	0.91 (0.66 - 1.25)	1.13 (0.76 - 1.69)
Animal food production	0.88 (0.70 - 1.11)	0.83 (0.59 - 1.17)	0.72** (0.52 - 0.99)	0.69 (0.41 - 1.14)	1.11 (0.78 - 1.56)	1.45 (0.87 - 2.43)	1.45** (1.04 - 2.02)	0.90 (0.55 - 1.47)
Vitamin A rich food production	1.10 (0.88 - 1.36)	1.13 (0.82 - 1.55)	0.88 (0.65 - 1.20)	0.99 (0.62 - 1.58)	0.98 (0.72 - 1.36)	1.00 (0.62 - 1.60)	2.25*** (1.63 - 3.10)	1.55* (0.96 - 2.52)
Farm production diversity score								
NO	1	1	1	1	1	1	1	1
1-2	0.90 (0.67 - 1.20)	1.16 (0.71 - 1.89)	1.59* (0.92 - 2.73)	1.30 (0.66 - 2.58)	0.68 (0.31 - 1.47)	0.49 (0.19 - 1.28)	1.79** (1.01 - 3.14)	1.00 (0.49 - 2.04)
3-5	1.56** (1.04 - 2.33)	1.05 (0.60 - 1.83)	1.11 (0.66 - 1.84)	1.26 (0.58 - 2.77)	0.67 (0.33 - 1.39)	0.37* (0.13 - 1.02)	2.33*** (1.38 - 3.93)	1.02 (0.46 - 2.26)
6-12	1.34 (0.92 - 1.94)	1.06 (0.55 - 2.04)	0.91 (0.53 - 1.57)	1.25 (0.49 - 3.15)	0.67 (0.30 - 1.49)	0.32* (0.10 - 1.06)	3.16*** (1.72 - 5.78)	1.16 (0.44 - 3.05)
Vitamin A HH consumption	1.13 (0.75 - 1.71)	0.95 (0.67 - 1.33)	0.84 (0.56 - 1.26)	0.91 (0.55 - 1.50)	0.75 (0.49 - 1.15)	0.84 (0.50 - 1.41)	1.34 (0.85 - 2.10)	1.37 (0.81 - 2.33)
Iodised Salt	0.93 (0.72 - 1.21)	1.12 (0.83 - 1.52)	1.18 (0.78 - 1.77)	1.22 (0.75 - 1.98)	0.84 (0.60 - 1.17)	0.92 (0.61 - 1.37)	0.71 (0.47 - 1.07)	1.01 (0.62 - 1.65)
HDDS								
1-4	1	1	1	1	1	1	1	1
5-8	0.66*** (0.53 - 0.83)	0.76* (0.57 - 1.02)	0.65** (0.47 - 0.91)	0.72 (0.46 - 1.12)	0.79 (0.57 - 1.09)	0.75 (0.48 - 1.18)	0.74* (0.54 - 1.02)	0.88 (0.58 - 1.33)
9-12	0.96 (0.52 - 1.80)	1.50 (0.73 - 3.06)	1.25 (0.59 - 2.66)	2.17 (0.80 - 5.91)	0.50 (0.18 - 1.37)	0.79 (0.22 - 2.83)	0.25* (0.05 - 1.21)	0.10* (0.01 - 1.11)
Home garden	1.25* (0.99 - 1.58)	1.11 (0.82 - 1.49)	0.97 (0.66 - 1.43)	1.04 (0.62 - 1.75)	0.92 (0.66 - 1.27)	0.93 (0.62 - 1.41)	1.99*** (1.44 - 2.75)	1.40 (0.92 - 2.14)
Frequency buying fresh food								
Daily	1	1	1	1	1	1	1	1
2-3 times/week	1.09 (0.85 - 1.41)	1.06 (0.80 - 1.42)	0.91 (0.64 - 1.31)	1.09 (0.71 - 1.67)	1.27 (0.88 - 1.83)	1.10 (0.70 - 1.72)	1.46** (1.00 - 2.11)	0.92 (0.59 - 1.46)
Once a week	1.34 (0.93 - 1.93)	1.18 (0.78 - 1.80)	1.21 (0.72 - 2.01)	1.28 (0.68 - 2.43)	1.48 (0.85 - 2.58)	1.50 (0.76 - 2.98)	1.64* (0.99 - 2.72)	1.01 (0.55 - 1.85)
Less often	1.15 (0.80 - 1.65)	0.92 (0.60 - 1.41)	0.92 (0.52 - 1.62)	0.82 (0.40 - 1.66)	1.62* (0.97 - 2.70)	1.70 (0.90 - 3.24)	1.30 (0.80 - 2.13)	0.71 (0.39 - 1.30)
Mother, hours away								
Zero	1	1	1	1	1	1	1	1
1-3 hours	0.83 (0.61 - 1.11)	0.77 (0.55 - 1.07)	0.69* (0.46 - 1.05)	0.58** (0.36 - 0.94)	0.98 (0.63 - 1.53)	1.20 (0.72 - 2.00)	1.32 (0.86 - 2.01)	1.21 (0.74 - 1.97)
4-7 hours	1.15	1.02	0.93	0.81	1.64**	1.66**	1.63**	1.31

	(0.86 - 1.52)	(0.75 - 1.40)	(0.62 - 1.40)	(0.50 - 1.30)	(1.07 - 2.52)	(1.01 - 2.73)	(1.09 - 2.44)	(0.82 - 2.09)
8-24 hours	1.22	1.17	1.09	0.97	1.53*	1.95**	1.31	1.02
	(0.88 - 1.70)	(0.79 - 1.72)	(0.69 - 1.73)	(0.55 - 1.71)	(0.97 - 2.39)	(1.15 - 3.31)	(0.76 - 2.27)	(0.54 - 1.94)
Urban Residence	1.24	1.33	1.74***	2.02***	0.74*	0.61**	0.47***	0.90
	(0.95 - 1.61)	(0.94 - 1.88)	(1.18 - 2.57)	(1.21 - 3.39)	(0.52 - 1.04)	(0.39 - 0.95)	(0.31 - 0.72)	(0.51 - 1.58)
Region								
Mbeya	1	1						
Njombe	1.83***	1.77***						
	(1.47 - 2.29)	(1.33 - 2.35)						
Iringa	1.27**	1.37**						
	(1.02 - 1.59)	(1.04 - 1.79)						

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