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## Research Article

# Prevalence of stunting and effect of nutrition intervention package on stunting in Rwanda

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## Abstract

**Background:** In Rwanda, interventions have been put in place aimed at reducing stunting among under 5 years children but until now, its prevalence nationwide remains high (33%). A post-program quasi-experimental study was conducted among children between 0 and 24 months in two intervention districts, and two control districts to assess the impact of a nutrition intervention package implemented by a program named Gikuriro.

**Results:** At the end of the Gikuriro program, the prevalence of stunting was 32.2% and 26.9% respectively in the intervention group and in the control group. There was no statistical difference between the 2 groups (Chi-square = 0.785,  $p$  - value = 0.376) and no observed effect of the nutrition intervention package on stunting (AOR = 1.206, CI at 95% [0.638 - 2.278],  $p$  - value = 0.564). Births in the last three years, child's age, child's birth size, wealth index, frequency of listening to radio, and months of breastfeeding were associated with stunting in the intervention group whereas in the control group, stunting was associated with receiving multiple micronutrients in last 7 days and beating justified if wife goes without telling husband.

**Conclusion:** A second study is advised before deciding whether to scale up nutrition programs aimed at reducing stunting since only end program evaluation was considered and the stunting trend between baseline and end line has not been evaluated additionally there were some particular initiatives put in place aiming at reducing stunting in the control group.

## Introduction

Childhood stunting is one of the most significant obstacles to human development. Approximately 156 million of the world's children under the age of 5 years are stunted, with an estimated 80% of these children concentrated in only 14 countries [1]. Stunting in children under five years of age declined from 32.6% of all the world's children under 5 years of age in 2000 to 22.2% in 2017. In numbers, this is a decline from 198.4 million to 150.8 million. Currently, the prevalence of childhood stunting in Africa ranges from 5% to 65% among the less-developed countries [2]. The prevalence of stunting among children under the age of 5 years remains persistently high in Rwanda. According to the Rwandan Demographic and Health Survey (RDHS, 2014 - 2015), stunting was 38% of

children under the age of 5 years and is currently 33% (RDHS 2019 - 2020).

According to the Lancet series 2013, several nutrition-specific and nutrition-sensitive interventions have been selected to address the problem of stunting [3,4]. Adapted from the Lancet series, the Gikuriro program has implemented an intervention package to improve the nutritional status of women of reproductive age and children under five years of age, especially in the first 1,000 days of life. Gikuriro program ("Integrated Nutrition and WASH Activity") was a 5-year (2016 - 2020) USAID-funded Integrated Nutrition and WASH Activity (INWA), and the key areas of intervention of this program were Nutrition education and counseling, as a nutrition-specific intervention, Water-Hygiene and Sanitation activities,

capacity strengthening, and Behavior Change Communication (BCC) as a nutrition-sensitive intervention.

Even though the Gikuriro program assessed the progress made over five years and the impact regarding Nutrition and WASH indicators in the five target districts of its implementation (Nyarugenge, Kicukiro, Nyabihu, Ngoma, Kayonza), the stunting status of children under 24 months has not been documented at the end of the program and needs to be assessed. In addition, factors associated with stunting of children under 24 months and the effect of the nutrition intervention package on stunting following the Gikuriro nutrition intervention package were also found to be assessed to complete the Gikuriro final evaluation.

Nutrition interventions have been conducted to address the problem of stunting. It is for example the case of a study entitled “Multisector intervention to accelerate reductions in child stunting: an observational study from 9 sub-Saharan African countries” where it has been examined changes in childhood stunting after 3 years of exposure to an integrated, multisector intervention related to agriculture and to health. After 3 years of program exposure, children 2 years of age had a 43% lower risk of being stunted than before project initiation [5].

In contrast to the above study, there is a study conducted in rural Malawi with the aim of reducing stunting but failed to show a decrease in stunting in a population of children 12 months – 35 months old. It was a combined intervention consisting of zinc, albendazole, and a daily multiple micronutrient powder

(MNP) to reduce stunting over 24 weeks [6]. Again, a study conducted by Kristina Michaux in 2015 with among others the aim to determine if Home Fortification (HF) with MNP is an effective strategy to reduce stunting in children 6 months – 24 months in Rwanda showed no significant effect after one year of followed up [7]. The reason why the above 2 studies failed to demonstrate significant benefits in stunting is may be the limitation in terms of duration of the interventions and in terms of diversification of components of interventions.

The specific objectives of this study were to determine the prevalence rate of stunting children after birth until 24 months, to identify the factors associated with stunting, and to assess the effect of nutrition specific and nutrition sensitive intervention package on stunting.

## Methods and materials

### Study area description

The study was conducted in Rwanda and falls within a USAID funded Integrated Nutrition and Water, Sanitation, and Hygiene (WASH) Activity (INWA) which has been renamed in Kinyarwanda Gikuriro Program. It covered five Districts including Kayonza, Ngoma (Eastern Province), Nyabihu District (Western Province), Nyarugenge and Kicukiro (City of Kigali). As it is displayed in Figure 1, the intervention group came from Nyarugenge District (urban area) and Nyabihu District (rural area), two out of the 5 Districts where intervention package has been implemented and the control group came from Gasabo District (urban area) and Ngororero District (rural area).

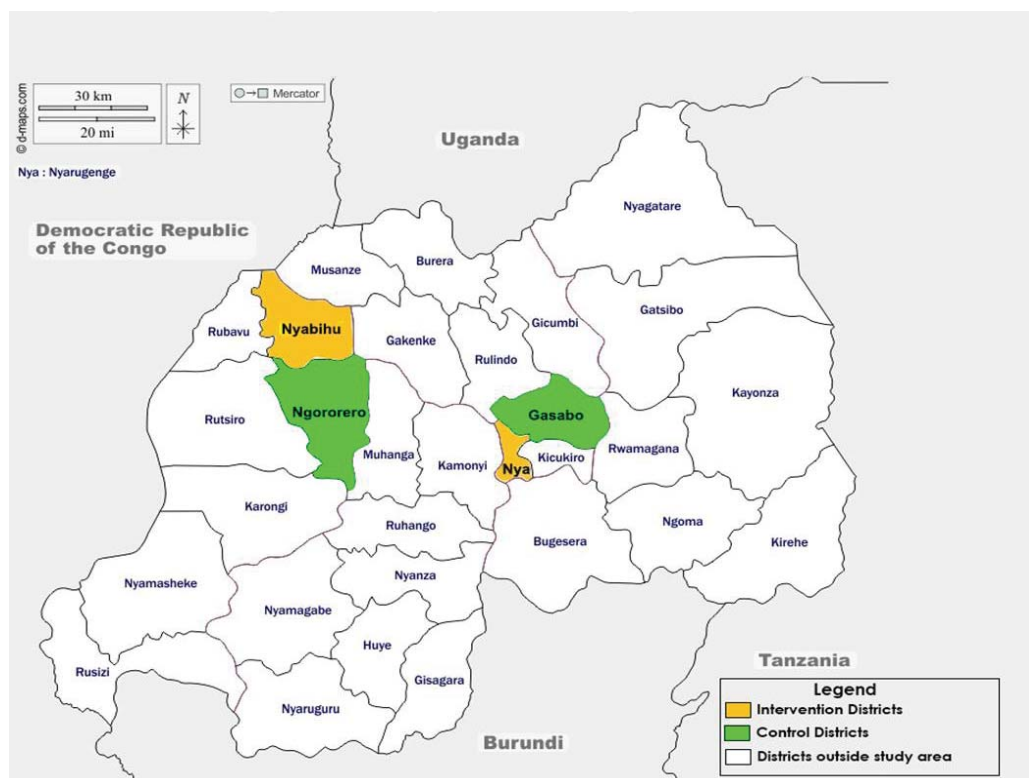


Figure 1: Map of the Study Area.



## Study design

It was a quasi-experimental study including two groups: an intervention group and a control group. The intervention group was made up of all the children aged between 0 - 24 months inclusively at the end of Gikuriro implementation program as well as their mothers in the Districts of Nyarugenge and Nyabihu selected purposively as urban (Nyarugenge) and rural (Nyabihu) Districts. The intervention group benefited from the program for 2 years towards the end of the intervention in September 2020. Data were retrieved from 2019 - 2020 Rwanda DHS open access dataset (United States Agency for International Development Demographic and Health Survey, data) available from: <http://dhsprogram.com/data>. The RDHS followed a two-stage sample design with the use of cross-sectional surveys during data collection.

The comparison group was made up of all the children born at the same time as for the intervention group as well as their mothers in the District of Gasabo (urban District) and Ngororero (rural District). This group has not been exposed to Gikuriro program. Data were also based on 2019 - 2020 Rwanda Demographic and Health Survey.

## Description of the intervention

Nutrition intervention package targeting children after birth until two years were divided in nutrition specific intervention package and nutrition sensitive intervention package. Nutrition specific intervention package was focused on awareness and practice of the mothers on IYCF (early initiation of breastfeeding, exclusive breastfeeding, and promotion of continued breastfeeding, adequate complementary feeding practice), education on micronutrient supplementation, distribution of Vitamin A and Vitamin K, micronutrients distribution, deworming tablets distribution.

Nutrition sensitive intervention package was related mainly to increased agricultural productivity, economic strengthening, and WASH activities.

Nutrition specific intervention package was focused on education program in the Village Nutrition Schools, where mothers learn cooking practice, preparation of balanced diet, best feeding practice, and preparation of kitchen garden. In addition, the community was supplied with small animals, poultry, and seeds to enable it to prepare a balanced diet for children under five years of age. Some equipment and kitchen utensils were provided. Were also implemented: child-growth monitoring (measuring the child's weight, height, and upper-arm circumference) to determine if the child is at risk of malnutrition and to take action accordingly, training for mothers with malnourished children coupled with providing these children with a balanced diet after obtaining their baseline anthropometric measurements, mobilizing men to participate in their children's nutrition.

Nutrition sensitive intervention package was focused on increased agricultural productivity (Kitchen Garden), Economic strengthening and WASH activities.

Increased agricultural productivity (Kitchen Garden), Economic strengthening: introduction of FFLSs (Farmer Field Learning School) so people can acquire learnings related to farming, economic empowerment activities through SILCs (Saving and Internal Lending Communities), with income-generating activities to economically empower community members to have better nutrition and hygiene as well as the capacity to pay for health insurance, leading to better access to health services.

**WASH activities:** training of community members on WASH behavior changes such as hand washing, waste management, and toilet use, promoting personal and household hygiene by CHWs, support of community-owned initiatives such communities addressing hygiene problems by building latrines, provision of water tanks to vulnerable households, promotion of drinking clean and boiled water using clean containers, improving water access by installation of piped water and increasing water sources, helping the community members in sanitation and hygiene practice through clubs, thereby contributing to the prevention of diarrheal diseases, which are a contributing factor of malnutrition among children under five years of age.

## Specific objectives achievement

To determine the prevalence rate of stunting among children from after birth until 24 months in the intervention group and in the comparison group, we used data from RDHS 2020 (open access dataset 2019 - 2020 available from: <http://dhsprogram.com/data>) where stunting status was recorded in the data set for each eligible child. Stunting was defined as a z-score lower than minus two standard deviations (-2 SD) from the mean of the reference population.

To determine the factors associated with stunting, a logistic regression model with significant independent variables in bivariate analysis was performed by calculating odds ratio (OR), 95% confidence interval (CI) and *p* - value. Then a final logistic regression model was performed by controlling the confounding factors.

To assess the effect of nutrition specific and nutrition sensitive intervention package on stunting, logistic regression model was used to determine if children in intervention group were less likely to be stunted comparatively to the children in the comparison group.

## Study population

**Sample size calculation:** Given that the target group of this study was small, this research used a total population sampling method, where the whole population of interest has been studied. Thus, all the children aged 0 - 24 months inclusively and their mothers in the districts of Nyarugenge and Nyabihu as intervention districts and in the districts of Gasabo and Ngororero as control districts by the end of 2020 RHDS have been considered. The children were selected in the Children's Recode dataset. For eligibility, only children for whom anthropometric measurements (age, weight, and height) were conducted were considered in this study.

Out of 8092 under five years children whose mothers were interviewed during the 2020 RDHS, the present study sample comprised of 234 children aged 0 - 24 months inclusively who met the inclusion criteria for this study meaning living in the four selected districts, namely Nyarugenege, Nyabihu, Gasabo and Ngororero and for whom anthropometric measurements (age, weight, height) were conducted during the 2020 RDHS. The total number in intervention group was 115 (Nyarugenge: 57 and Nyabihu: 58). The total number in control group was 119 (Gasabo: 74 and Ngororero: 45)

**Sampling techniques:** As shown in Figure 2, out of 8092 children under the age of five nationwide who were extracted from the RDH 2020 Children's Recode dataset, 3821 had valid anthropometric measurements, and 1634 of those children were selected as being under the age of two years. Among them, 234 came from the four districts that were chosen: 57 from Nyarugenge District, 58 from Nyabihu District, 74 from Gasabo District, and 45 from Ngororero District.

**Data collection procedures and tools:** Data were retrieved from the Rwanda Demographic and Health Survey (2019 - 2020). The RDHS followed a two-stage sample design with the use of cross-sectional surveys during data collection. A total of 500 census enumeration areas (EAs) selected in the first stage and a systematic sample of 13,000 households selected in the second stage. Data collection took place from November 9, 2019, to July 20, 2020 (National Institute of Statistics of Rwanda, Ministry of Health (MOH) [Rwanda], ICF. Kigali, Rwanda and Rockville. Maryland, USA: NISR and ICF; 2021. Rwanda Demographic and Health Survey 2019 - 20 Final Report. Accessed on Dec 10, 2021). The variables included in this study were: socio demographic characteristics of the mother and the child, socio economic characteristics of the mother and the child, nutrition interventions toward the mother and the child.

## Data analysis

The analysis was performed using IBM SPSS Statistics version 25.

Univariate analysis was performed and descriptive statistics using percentage and number of distribution of the mother-child pairs by socio demographic characteristics, socio economic characteristics, nutrition interventions toward the mother and the child were computed. In the next step, bivariate analysis with Pearson chi-square tests was performed to clarify the significant variables with stunting in intervention and control Districts. The results were considered statistically significant at  $p < 0.05$ . In the final step, a multivariable logistic regression analysis was conducted to identify the key risk factors associated with stunting in intervention and control groups. All the variables that were significant at a 5% level of significance ( $p$  - values  $< 0.05$ ) in the bivariate analyses were considered for the subsequent multivariable analysis. Adjusted Odds ratios and their 95 % confidence intervals were computed and statistical significance was defined as  $p \leq 0.05$ .

Effect of nutrition interventions on stunting was assessed by using logistic regression analysis.

## Results

### Socio demographic characteristics of the study population

A total of 115 mother-child pairs for intervention group and 119 mother-child pairs for control group were considered in the study. When comparing the basic demographic characteristics of the participants, there was a significant difference between intervention and control groups for the age of the mother ( $p$  - value = 0.027), number of children under 5 years in the

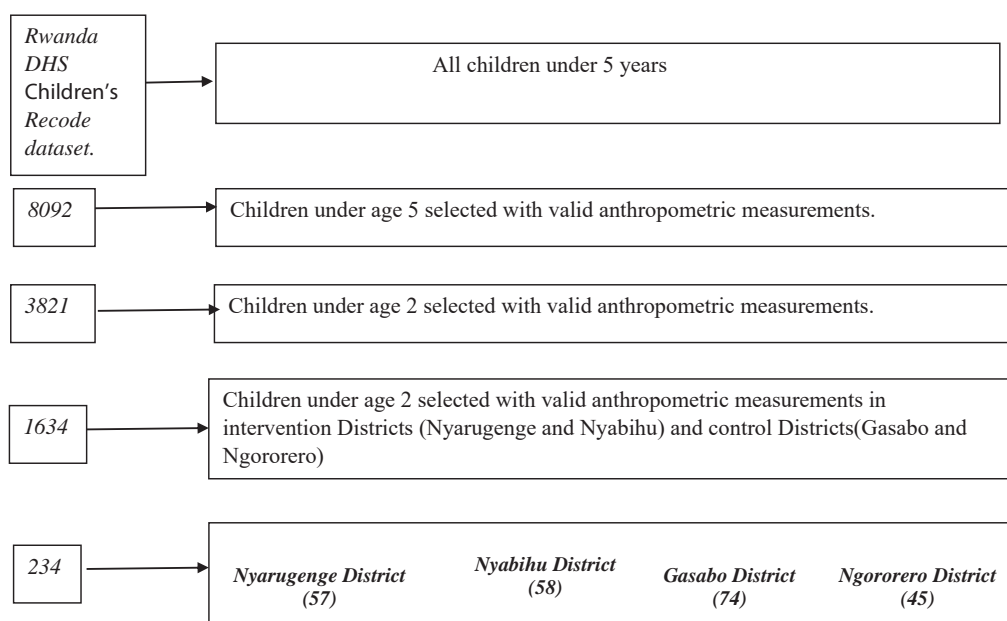


Figure 2: Sample selection.



household ( $p$  - value = 0.034), age of the mother when she got her first born ( $p$  - value = 0.033), sex of the child ( $p$  - value = 0.004), size of the child ( $p$  - value = 0.034), birth weight ( $p$  - value = 0.049) (Table 1).

### Socio economic characteristics of the study population

When comparing the socio economic characteristics of the participants, there was a significant difference between intervention and control groups for the frequency of watching television ( $p$  - value < 0.001) and the type of cooking fuel ( $p$  - value < 0.001) (Table 2).

### Nutrition intervention towards the study population

When comparing nutrition intervention received by children, there was a significant difference between intervention and control groups for the number of times ate solid, semi-solid or soft food yesterday ( $p$  - value = 0.024), participated in monthly

**Table 1:** Socio demographic characteristics of the study population in intervention and control group.

Variables	Intervention group (n = 115)	Control group (n = 119)	Total (n = 234)	$\chi^2$	$p$ - value
	%(n)	%(n)	%(n)		
Age of the mother(in years)					
15-25	29.6(34)	27.7(33)	28.6(67)	7.257	0.027 *
26-35	53.9(62)	41.2(49)	47.5(111)		
36 and above	16.5(19)	31.1(37)	23.9(56)		
Place of the residence					
Rural	58.3(67)	60.5(72)	59.4(139)	0.122	0.727
Urban	41.7(48)	39.5(47)	40.6(95)		
Education					
No education	9.6(11)	9.2(11)	9.4(22)	1.791	0.617
Primary level	56.5(65)	58.0(69)	57.3(134)		
Secondary level	27.8(32)	22.7(27)	25.2(59)		
Higher education level	6.1(7)	10.1(12)	8.1(19)		
Number of family members in the household					
1-5	63.5(73)	56.3(67)	59.8(140)	4.59	0.101
6-10	36.5(42)	40.3(48)	38.5(90)		
11 and above	0.0(0)	3.4(4)	1.7(4)		
Sex of household head					
Female	27.8(32)	22.7(27)	25.2(59)	0.818	0.366
Male	72.2(83)	77.3(92)	74.8(175)		
Number of children under 5 years in the household					
0-2	90.4(104)	80.7(96)	85.5(200)	4.488	0.034 *
3-6	9.6(11)	19.3(23)	14.5(34)		
Religion					
Christian	94.8(109)	93.3(111)	94.0(220)	1.027	0.598
Muslim	5.2(6)	3.4(4)	4.3(10)		
Other	0.0(0)	3.4(4)	1.7(4)		
Age of the mother when she got her first born					

13-25	89.6(103)	79.0(94)	84.2(197)	6.799	0.033 *
26-35	10.4(12)	17.6(21)	14.1(33)		
36 and above	0.0(0)	3.4(4)	1.7(4)		
Number of children the mother has given birth to					
1-5	87.8(101)	89.9(107)	88.9(208)	0.259	0.611
6-10	12.2(14)	10.1(12)	11.1(26)		
Number children still alive					
1-5	92.2(106)	93.3(111)	92.7(217)	0.106	0.745
6-10	7.8(9)	6.7(8)	7.3(17)		
Births in last five years					
1	51.3(59)	43.7(52)	47.4(111)	1.832	0.400
2	43.5(50)	47.9(57)	45.7(107)		
3	5.2(6)	8.4(10)	6.8(16)		
Births in last three years					
1	82.6(95)	78.2(93)	80.3(188)	0.736	0.391
2	17.4(20)	21.8(26)	19.7(46)		
Marital status					
Married and living with partner	89.6(103)	84.9(101)	87.2(204)	1.152	0.283
Single/divorced / widowed/ separated	10.4(12)	15.1(18)	12.8(30)		
Currently residing with husband/partner					
Currently residing with her	88.3(91)	84.2(85)	86.3(176)	0.756	0.384
Staying elsewhere	11.7(12)	15.8(16)	13.7(28)		
Husband/partner's education level					
No education	8.0(8)	18.0(18)	13.0(26)	7.497	0.058
Primary level	67.0(67)	55.0(55)	61.0(122)		
Secondary level	19.0(19)	15.0(15)	17.0(34)		
Higher education level	6.0(6)	12.0(12)	9.0(18)		
Husband's age ( in years)					
15-25	13.6(14)	8.9(9)	11.3(23)	1.776	0.411
26-35	44.7(46)	41.6(42)	43.1(88)		
36 and above	41.7(43)	49.5(50)	45.6(93)		
Sex of the child					
Female	39.1(45)	58.0(69)	48.7(114)	8.320	0.004 *
Male	60.9(70)	42.0(50)	51.3(120)		
Child's age( in months)					
0-10	49.6(57)	51.3(61)	50.4(118)	2.731	0.255
11-20	39.1(45)	31.1(37)	35.0(82)		
21-24	11.3(13)	17.6(21)	14.5(34)		
Size of the child					
Larger than average	39.5(45)	24.6(29)	31.9(74)	6.740	0.034 *
Average	47.4(54)	54.2(64)	50.9(118)		
Smaller than average	13.2(15)	21.2(25)	17.2(40)		
Birth weight (in kg)					
1.000-2.000	1.7(2)	3.4(4)	2.6(6)	7.838	0.049 *
2.100-3.000	30.4(35)	45.4(54)	38.0(89)		
3.100-4.000	55.7(64)	45.4(54)	50.4(118)		
4.100 and above	12.8(14)	5.9(7)	9.0(21)		

\*Significant variables with a  $p$  - value < 0.05



growth monitoring and nutrition promotion sessions ( $p$  - value = 0.042), source of drinking water ( $p$  - value = 0.001), toilet facility shared with other households ( $p$  - value = 0.042) (Table 3).

### Prevalence of stunting in intervention and control groups

As shown in Table 4, the prevalence of stunting for children

**Table 2:** Socio economic characteristics of the study population in intervention and control group.

Variables	Intervention group	Control group	Total	$\chi^2$	$p$ - value
	%(n)	%(n)	%(n)		
Occupation of the mother					
Unemployed	29.6(34)	31.1(37)	30.3(71)	5.416	0.144
Farming/agriculture	27.8(32)	26.9(32)	27.4(64)		
Self employed	18.3(21)	27.7(33)	23.1(54)		
Salaried	24.3(28)	14.3(17)	19.22(45)		
Occupation of the father					
Unemployed	4.9(5)	5.2(5)	5.0(10)	0.581	0.901
Farming/ agriculture(agriculture-employee)	23.3(24)	27.8(27)	25.5(51)		
Self-employees (unskilled and skilled manual)	46.6(48)	43.3(42)	45.0(90)		
Salaried employees	25.2(26)	23.7(23)	24.5(49)		
Wealth index					
Poor	27.8(32)	38.7(46)	33.3(78)	3.128	0.209
Middle	14.8(17)	11.8(14)	13.2(31)		
Rich	57.4(66)	49.6(59)	53.4(125)		
Covered by Health Insurance					
No	26.1(30)	18.5(22)	22.2(52)	1.954	0.162
Yes	73.9(85)	81.5(97)	77.8(182)		
Household has electricity					
Yes	63.6(70)	56.8(67)	60.1(137)	1.116	0.291
No	36.4(40)	43.2(51)	39.9(91)		
Household has Radio					
Yes	38.2(42)	43.2(51)	40.8(93)	0.598	0.439
No	61.8(68)	56.8(67)	59.2(135)		
Household has television					
Yes	19.1(21)	28.0(33)	23.7(54)	2.481	0.115
No	80.9(89)	72.0(85)	76.3(174)		
Main roof material					
Metal sheet	78.2(86)	66.1(78)	71.9(164)	4.687	0.096
Ceramic tiles	21.8(24)	33.1(39)	27.6(63)		
Other	0.0(0)	0.8(1)	0.4(1)		
Frequency of using internet					
Not at all	87.0(100)	82.4(98)	84.6(198)	4.503	0.212
Less than once a week	0.9(1)	0.8(1)	0.9(2)		
At least once a week	7.0(8)	4.2(5)	5.6(13)		
Almost every day	5.2(6)	12.6(15)	9.0(21)		
Frequency of watching television					

Not at all	67.0(77)	41.2(49)	53.8(126)	15.640	0.000 *
Less than once a week	16.5(19)	29.4(35)	23.1(54)		
At least once a week	16.5(19)	29.4(35)	23.1(54)		
Frequency of listening to radio					
Not at all	22.6(26)	21.0(25)	21.8(51)	1.303	0.521
Less than once a week	13.0(15)	18.5(22)	15.8(37)		
At least once a week	64.3(74)	60.5(72)	62.4(146)		
Type of cooking fuel					
Electricity + LGP/Natural gas	2.7(3)	11.9(14)	7.5(17)	27.456	0.000 *
Charcoal	43.6(48)	27.1(32)	35.1(80)		
Wood	29.1(32)	52.5(62)	41.2(94)		
Straw/Shrubs/grass	24.5(27)	8.5(10)	16.2(37)		
Owens a mobile phone					
Yes	48.7(56)	50.4(60)	49.6(116)	0.070	0.792
No	51.3(59)	49.6(59)	50.4(118)		
Use of internet					
Never	84.3(97)	78.2(93)	81.2(190)	1.473	0.479
Yes, last 12 months	13.9(16)	19.3(23)	16.7(39)		
Yes, before last 12 months	1.7(2)	2.5(3)	2.1(5)		
Frequency of using internet last month					
Not at all	87.0(100)	82.4(98)	84.6(198)	4.503	0.212
Less than once a week	0.9(1)	0.8(1)	0.9(2)		
At least once a week	7.0(8)	4.2(5)	5.6(13)		
Almost every day	5.2(6)	12.6(15)	9.0(21)		

\*Significant variables with a  $p$  - value < 0.05.

aged 0 - 24 months was 32.2% and 26.9 % respectively in intervention group and in control group at the end of Gikuriro intervention. There was no statistically significant difference between intervention and control group (Chi square = 0.785,  $p$  value = 0.376).

### Stunting and socio demographic characteristics of the study population

#### a) Bivariate analysis in intervention and control groups:

As shown in Table 5, the following variables were significant ( $p < 0.05$ ):

- **In intervention group:** Births in last five years, births in last three years, child's age, size of the child and birth weight
- **In control group:** Sex of household head, number of children under 5 years in the household, births in last five years, births in last three years, currently residing with husband/partner and birth weight.

#### b) Multivariate analysis: Factors associated with stunting in intervention and control groups:

Table 6 displays the final results in multivariate analysis for the intervention group and the control group:

**Intervention group:** Children from households with 2 births in last three years were 7 times more likely to be stunted (AOR = 7.471, CI at 95% [1.357 - 41.123],  $p$  - value = 0.021) compared



**Table 3:** Nutrition intervention towards the study population.

Variables	Intervention group	Control group	Total	χ <sup>2</sup>	p - value
	%(n)	%(n)	%(n)		
Currently child breastfed					
Yes	96.5(111)	92.4(110)	94.4(221)	1.86	0.173
No	3.5(4)	7.6(9)	5.6(13)		
Child put to breast within one hour					
Yes	86.4(95)	89.2(99)	87.8(194)	0.411	0.521
No	13.6(15)	10.8(12)	12.2(27)		
Duration of breastfeeding					
Ever breastfed, not currently breastfed	6.1(7)	10.9(13)	8.5(20)	2.108	0.349
Never breastfed	0.9(1)	1.7(2)	1.3(3)		
Still breastfed	93.0(107)	87.4(104)	90.2(211)		
Months of breastfeeding					
0-6	28.7(33)	26.9(32)	27.8(65)	2.765	0.429
7-12	25.2(29)	27.7(33)	26.5(62)		
13-24	39.1(45)	32.8(39)	35.9(84)		
Not currently breastfed and never breastfed	7.0(8)	12.6(15)	9.8(23)		
Drank from bottle with nipple yesterday/ last night					
Yes	8.7(10)	13.4(16)	11.1(26)	1.336	0.248
No	91.3(105)	86.6(103)	88.9(208)		
Did eat any solid, semi-solid or soft foods yesterday					
Yes	73.4(80)	70.9(78)	72.1(158)	0.168	0.682
No	26.6(29)	29.1(32)	27.9(61)		
Number of times ate solid, semi-solid or soft food yesterday					
0-2	67.6(73)	80.9(89)	74.3(162)	5.062	0.024 *
3 and more	32.4(35)	19.1(21)	25.7(56)		
Given child anything other than breast milk					
Yes	6.4(7)	5.4(6)	5.9(13)	0.092	0.762
No	93.6(103)	94.6(105)	94.1(208)		
Vitamin A in last 6 months					
Yes	54.8(63)	58.8(70)	56.8(133)	0.389	0.533
No	45.2(52)	41.2(49)	43.2(101)		
Drugs for intestinal parasites in last 6 months					
Yes	43.5(50)	42.0(50)	42.7(100)	0.051	0.821
No	56.5(65)	58.0(69)	57.3(134)		
In the last 7 days given: local name for multiple micronutrient powder					
Yes	13.9(16)	13.4(16)	13.7(32)	0.011	0.917
No	86.1(99)	86.6(103)	86.3(202)		
Given zinc					
Yes	39.1(9)	24.0(6)	31.3(15)	1.276	0.259
No	60.9(14)	76.0(19)	68.8(33)		
Participated in monthly growth monitoring and nutrition promotion sessions					
Yes	23.9(27)	36.2(42)	30.1(69)	4.122	0.042 *
No	76.1(86)	63.8(74)	69.9(160)		

Source of drinking water					
Piped of all kind + bottled water	20.9(23)	22.9(27)	21.9(50)	16.68	0.001 *
Public tap/standpipe	40.0(44)	19.5(23)	29.4(67)		
Protected well and protected spring	28.2(31)	50.8(60)	39.9(91)		
Unprotected spring, river/dam/lake /rainwater/cart with small tank	10.9(12)	6.8(8)	8.8(20)		
Type of toilet					
Flush toilet of all kind	6.4(7)	11.0(13)	8.8(20)	2.601	0.272
Pit toilet of all kind	90.9(100)	88.1(104)	89.5(204)		
No facility/bush /field	2.7(3)	0.8(1)	1.8(4)		
Toilet facility shared with other households					
Yes	42.10(45)	29.1(34)	35.3(79)	4.135	0.042 *
No	57.9(62)	70.9(83)	64.7(145)		
Beating justified if wife argues with husband					
Yes	31.3(36)	26.1(31)	28.6(67)	0.79	0.374
No	68.7(79)	73.9(88)	71.4(167)		
Beating justified if wife refuses to have sex with husband					
Yes	27.8(32)	21.8(26)	24.8(58)	1.121	0.290
No	72.2(83)	78.2(93)	75.2(176)		
Beating justified if wife burns the food					
Yes	15.7(18)	16.8(20)	16.2(38)	0.057	0.811
No	84.3(97)	83.2(99)	83.8(196)		
Beating justified if wife goes out without telling husband					
Yes	35.7(41)	29.4(35)	32.5(76)	1.039	0.308
No	64.3(74)	70.6(84)	67.5(158)		
Attend community parenting session in Education Community facility					
Yes	13.9(16)	13.4(16)	13.7(32)	0.011	0.917
No	86.1(99)	86.6(103)	86.3(202)		
Person who usually decides how to spend respondent's earnings					
Mother alone	27.8(15)	30.2(16)	29.0(31)	0.106	0.948
Mother and husband/partner	57.4(31)	56.6(30)	57.0(61)		
Husband/partner alone	14.8(8)	13.2(7)	14.0(15)		
Person who usually decides on: respondent's health care					
Mother alone	26.2(27)	31.7(32)	28.9(59)	6.406	0.093
Mother and husband/partner	38.8(40)	48.5(49)	43.6(89)		
Husband/partner alone	34.0(35)	19.8(20)	27.0(55)		
Someone else	1.0(1)	0.0(0)	0.5(1)		

\*Significant variables with a p - value < 0.05.

**Table 4:** Prevalence of stunting for children aged 0 - 24 months in intervention and control group.

Group	Stunting status			Chi square	p - value
	Yes %(n)	No %(n)	Total %(n)		
Intervention	32.2(37)	67.8(78)	100.0(115)	0.785	0.376
Control	26.9(32)	73.1(87)	100.0(119)		


**Table 5:** Bivariate analysis: Stunting and sociodemographic characteristics of the study population.

Variables	Intervention group					Control group				
	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value
Age of the mother(in years)										
15-25	17.6(6)	82.4(28)	100.0(34)	5.609	0.061	24.2(8)	75.8(25)	100.0(33)	0.188	0.910
26-35	35.5(22)	64.5(40)	100.0(62)			28.6(14)	71.4(35)	100.0(49)		
36 and above	47.4(9)	52.6(10)	100.0(19)			27.0(10)	73.0(27)	100.0(37)		
Place of the residence of the mother										
Rural	38.8(26)	61.2(41)	100.0(67)	3.235	0.072	31.9(23)	68.1(49)	100.0(72)	2.368	0.124
Urban	22.9(11)	77.1(37)	100.0(48)			19.1(9)	80.9(38)	100.0(47)		
Education of the mother (Highest education level)										
No education	45.5(5)	54.5(6)	100.0(11)	1.172	0.760	45.5(5)	54.5(6)	100.0(11)	7.082	0.068
Primary	32.3(21)	67.7(44)	100.0(65)			30.4(21)	69.6(48)	100.0(69)		
Secondary	28.1(9)	71.9(23)	100.0(32)			22.2(6)	77.8(21)	100.0(27)		
Higher education	28.6(2)	71.4(5)	100.0(7)			0.0(0)	100.0(12)	100.0(12)		
Number of family members in the household										
1-5	28.8(21)	71.2(52)	100.0(73)	1.063	0.303	23.9(16)	76.1(51)	100.0(67)	2.793	0.247
6-10	38.1(16)	61.9(26)	100.0(42)			33.3(16)	66.7(32)	100.0(48)		
11 and above						0.0(0)	100.0(4)	100.0(4)		
Sex of household head										
Female	31.3(10)	68.8(22)	100.0(32)	0.017	0.895	11.1(3)	88.9(24)	100.0(27)	4.423	0.035
Male	32.5(27)	67.5(56)	100.0(83)			31.5(29)	68.5(63)	100.0(92)		
Number of children under 5 years in the household										
0-2	30.8(32)	69.2(72)	100.0(104)	0.983	0.321	20.8(20)	79.2(76)	100.0(96)	9.270	0.002
3-6	45.5(5)	54.5(6)	100.0(11)			52.2(12)	47.8(11)	100.0(23)		
Religion of the mother										
Christian	33.0(36)	67.0(73)	100.0(109)	0.698	0.404	27.9(31)	72.1(80)	100.0(111)	1.539	0.463
Muslim	16.7(1)	83.3(5)	100.0(6)			0.0(0)	100.0(4)	100.0(4)		
Other						25.0(1)	75.0(3)	100.0(4)		
Age of the mother when she got her first born										
13-25	32.0(33)	68.0(70)	100.0(103)	0.008	0.928	28.7(27)	71.3(67)	100.0(94)	1.733	0.420
26-35	33.3(4)	66.7(8)	100.0(12)			23.8(5)	76.2(16)	100.0(21)		
36 and above						0.0(0)	100.0(4)	100.0(4)		
Number of children the mother has given birth to										
1-5	31.7(32)	68.3(69)	100.0(101)	0.092	0.762	25.2(27)	74.8(80)	100.0(107)	1.482	0.223
6-10	35.7(5)	64.3(9)	100.0(14)			41.7(5)	58.3(7)	100.0(12)		
Number children still alive										
1-5	32.1(34)	67.9(72)	100.0(106)	0.006	0.938	25.2(28)	74.8(83)	100.0(111)	2.330	0.127
6-10	33.3(3)	66.7(6)	100.0(9)			50.0(4)	50.0(4)	100.0(8)		
Births in last five years										
1	23.7(14)	76.3(45)	100.0(59)	9.460	0.009	15.4(8)	84.6(44)	100.0(52)	7.422	0.024
2	36.0(18)	64.0(32)	100.0(50)			33.3(19)	66.7(38)	100.0(57)		
3	83.3(5)	16.7(1)	100.0(6)			50.0(5)	50.0(5)	100.0(10)		
Births in last three years										
1	27.4(26)	72.6(69)	100.0(95)	5.781	0.016	21.5(20)	78.5(73)	100.0(93)	6.279	0.012
2	55.0(11)	45.0(9)	100.0(20)			46.2(12)	53.8(14)	100.0(26)		
Marital status										
Married and living with partner	32.0(33)	60.0(70)	100.0(103)	0.008	0.928	27.7(28)	72.3(73)	100.0(101)	0.235	0.628
Single/divorced / widowed/separated	33.3(4)	66.7(8)	100.0(12)			22.2(4)	77.8(14)	100.0(18)		





Currently residing with husband/partner										
Currently residing with her	33.0(30)	67.0(61)	100.0(91)	0.309	0.578	31.8(27)	68.2(58)	100.0(85)	4.375	0.036
Staying elsewhere	25.0(3)	75.0(9)	100.0(12)			6.3(1)	93.8(15)	100.0(16)		
Husband/partner's education level										
No education	50.0(4)	50.0(4)	100.0(8)	3.053	0.384	38.9(7)	61.1(11)	100.0(18)	6.811	0.078
Primary	34.3(23)	65.7(44)	100.0(67)			32.7(18)	67.3(37)	100.0(55)		
Secondary	78.9(15)	21.1(4)	100.0(19)			20.0(3)	80.0(12)	100.0(15)		
Higher education	16.7(1)	83.3(5)	100.0(6)			0.0(0)	100.0(12)	100.0(12)		
Husband's age ( in years)										
15-25	14.3(2)	85.7(12)	100.0(14)	2.345	0.310	33.3(3)	66.7(6)	100.0(9)	0.706	0.703
26-35	34.8(16)	65.2(30)	100.0(46)			31.0(13)	69.0(29)	100.0(42)		
36 and above	34.9(15)	65.1(28)	100.0(43)			24.0(12)	76.0(38)	100.0(50)		
Sex of the child										
Female	22.2(10)	77.8(35)	100.0(45)	3.355	0.067	23.2(16)	76.8(53)	100.0(69)	1.145	0.285
Male	38.6(27)	61.4(43)	100.0(70)			32.0(16)	68.0(34)	100.0(50)		
Child's age (in months)										
0-10	14.0(8)	86.0(49)	100.0(57)	26.240	0.000	23.0(14)	77.0(47)	100.0(61)	1.090	0.580
11-20	40.0(18)	60.0(27)	100.0(45)			32.4(12)	67.6(25)	100.0(37)		
21-24	84.6(11)	15.4(2)	100.0(13)			28.6(6)	71.4(15)	100.0(21)		
Size of the child										
Larger than average	17.8(8)	82.2(37)	100.0(45)	15.88	0.000	24.1(7)	75.9(22)	100.0(29)	1.273	0.529
Average	33.3(18)	66.7(36)	100.0(54)			25.0(16)	75.0(48)	100.0(64)		
Smaller than average	73.3(11)	26.7(4)	100.0(15)			36.0(9)	64.0(16)	100.0(25)		
Birth weight (in kg)										
1.000-2.000	100.0(2)	0.0(0)	100.0(2)	12.74	0.005	50.0(2)	50.0(2)	100.0(4)	7.93	0.047
2.100-3.000	48.6(17)	51.4(18)	100.0(35)			37.0(20)	63.0(34)	100.0(54)		
3.100-4.000	20.3(13)	79.7(51)	100.0(64)			14.8(8)	85.2(46)	100.0(54)		
4.100 and above	35.7(5)	64.3(9)	100.0(14)			28.6(2)	71.4(5)	100.0(7)		

to children from households with 1 birth in last three years; children aged 11 months - 20 months were almost 9 times more likely to be stunted (AOR = 8.828, CI at 95% [2.217 - 35.158],  $p$  - value = 0.002) compared to children aged 0-10 months; children aged 21-24 months were 113 times more likely to be stunted (AOR = 113.27, CI at 95% [13.047 - 983.417],  $p$  - value = 0.000) compared to children aged 0 - 10 months; children smaller in size than average were 16 times more likely to be stunted ( AOR = 16.072, CI at 95% [1.768 - 146.065],  $p$  - value = 0.014) compared to children larger than average; children with average size were 5 times more likely to be stunted ( AOR = 5.018, CI at 95% [1.167 - 21.577],  $p$  - value = 0.030) compared to children larger than average.

**Control group:** No variable was found significant in multivariate analysis.

### Stunting and socio economic characteristics of the study population

- a) **Bivariate analysis in intervention and control groups:** As shown in Table 7, the following variables were significant ( $p < 0.05$ ):

- **In intervention group:** Wealth index and frequency of listening to radio.
  - **In control group:** Wealth index, household has electricity, household has radio, household has television, main roof material, frequency of using internet, frequency of watching television, type of cooking fuel, owns a mobile phone, use of internet, frequency of using internet last month.
- b) **Multivariate analysis: Factors associated with stunting in intervention and control groups:** Table 8 displays the final results in multivariate analysis for the intervention group and the control group:

**Intervention group:** Children from poor households were almost 3 times more likely to be stunted (AOR = 2.673, CI at 95% [1.066 - 6.702],  $p$  - value = 0.036) compared to children from rich households; children from non-radio listening households were almost 3 times more likely to be stunted (AOR = 2.639, CI at 95% [1.066 - 6.923],  $p$  - value = 0.049) compared to children from households with a frequency of listening to radio of at least once a week.



**Table 6:** Multivariate Analysis: Stunting and Socio demographic characteristics of the study population.

Intervention group										Control group								
Variables	Yes	No	Total	COR	CI at 95%	p-value	AOR	CI at 95%	p-value	Yes	No	Total	COR	CI at 95%	p-value	AOR	CI at 95%	p-value
	%(n)	%(n)	%(n)							%(n)	%(n)	%(n)						
Sex of household head																		
Male										31.5(29)	68.5(63)	100.0(92)	3.683	1.026-13.222	0.046	5.766	0.191-174.113	0.134
Female										11.5(3)	88.5(24)	100.0(27)	1			1		
Number of children under 5 years in the household																		
1-2										20.8(20)	79.2(76)	100.0(96)	1			1		
3-6										52.2(12)	47.8(11)	100.0(23)	4.145	1.595-10.772	0.004	4.192	0.821-21.392	0.085
Births in last five years																		
1	23.7(14)	76.3(45)	100.0(59)	1			1			15.4(8)	84.6(44)	100.0(52)	1			1		
2	36.0(18)	64.0(32)	100.0(50)	0.062	0.007-0.578	0.015	1.204	0.308-4.712	0.790	33.3(19)	66.7(38)	100.0(57)	2.750	1.082-6.992	0.034	2.252	0.629-8.057	2.252
3	83.3(5)	16.7(1)	100.0(6)	0.113	0.012-1.039	0.054	7.992	0.607-105.285	0.114	50.0(5)	50.0(5)	100.0(10)	5.500	1.289-23.460	0.021	1.744	0.143-21.284	0.663
Births in last three years																		
1	27.4(26)	72.6(69)	100.0(95)	1			1			21.5(20)	78.5(73)	100.0(93)	1			1		
2	55.0(11)	45.0(9)	100.0(20)	3.244	1.206-8.727	0.020	7.471	1.357-41.123	0.021	46.2(12)	53.8(14)	100.0(26)	3.129	1.252-7.820	0.015	2.359	0.563-9.877	0.240
Currently residing with husband/partner																		
Currently residing with her										31.8(27)	68.2(58)	100.0(85)	6.983	0.877-55.620	0.066	1.506	0.050-45.054	0.813
Staying elsewhere										6.3(1)	93.8(15)	100.0(16)	1			1		
Child's age(in months)																		
0-10	14.0(8)	86.0(49)	100.0(57)	1			1											
11-20	40.0(18)	60.0(27)	100.0(45)	4.083	1.569-10.624	0.004	8.828	2.217-35.158	0.002									
21-24	84.6(11)	15.4(2)	100.0(13)	33.69	6.267-181.082	0.000	113.27	13.047-983.417	0.000									
Size of the child																		
Larger than average	17.8(8)	82.2(37)	100.0(45)	1			1											
Average	33.3(18)	66.7(36)	100.0(54)	2.312	0.894-5.985	0.084	5.018	1.167-21.577	0.030									
Smaller than average	73.3(11)	26.7(4)	100.0(15)	12.72	3.212-50.358	0.000	16.072	1.768-146.065	0.014									
Birth weight (in kg)																		
1.000-2.000	100.0(2)	0.0(0)	100.0(2)		0.000-	0.999		0.000-	0.999	50.0(2)	50.0(2)	100.0(4)	5.750	0.705-46.901	0.102	4.927	0.293-82.913	0.268
2.100-3.000	48.6(17)	51.4(18)	100.0(35)	3.705	1.506-9.114	0.004	2.713	0.634-11.598	0.178	37.0(20)	63.0(34)	100.0(54)	3.382	1.332-8.590	0.010	2.073	0.667-6.448	0.208
3.100-4.000	20.3(13)	79.7(51)	100.0(64)	1			1			14.8(8)	85.2(46)	100.0(54)	1			1		
4.100 and above	35.7(5)	64.3(9)	100.0(14)	2.179	0.624-7.618	0.222	2.243	0.420-11.986	0.345	28.6(2)	71.4(5)	100.0(7)	2.300	0.379-13.963	0.365	0.374	0.036-3.845	0.408

COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio; CI: 95% Confidence Interval



**Table 7:** Bivariate analysis: Stunting and socio economic characteristics of the study population.

Variables	Intervention group					Control group				
	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value
Occupation of the mother										
Unemployed	29.4(10)	70.6(24)	100.0(34)	1.396	0.706	27.0(10)	73.0(27)	100.0(37)	4.823	0.185
Farming/agriculture	31.3(10)	68.8(22)	100.0(32)			31.3(10)	68.8(22)	100.0(32)		
Self employed	42.9(9)	57.1(12)	100.0(21)			33.3(11)	66.7(22)	100.0(33)		
Salaried	28.6(8)	71.4(20)	100.0(28)			5.9(1)	94.1(16)	100.0(17)		
Occupation of the father										
Unemployed	60.0(3)	40.0(2)	100.0(5)	6.166	0.104	20.0(1)	80.0(4)	100.0(5)	0.375	0.945
Farming/agriculture	41.7(10)	58.3(14)	100.0(24)			29.6(8)	70.4(19)	100.0(27)		
Unskilled and skilled manual	33.3(16)	66.7(32)	100.0(48)			31.0(13)	69.0(29)	100.0(42)		
Salaried employees	15.4(4)	84.6(22)	100.0(26)			26.1(6)	73.9(17)	100.0(23)		
Wealth index										
Poor	50.0(16)	50.0(16)	100.0(32)	6.622	0.036	41.3(19)	58.7(27)	100.0(46)	13.453	0.001
Middle	29.4(5)	70.6(12)	100.0(17)			42.9(6)	57.1(8)	100.0(14)		
Rich	24.2(16)	75.8(50)	100.0(66)			11.9(7)	88.1(52)	100.0(59)		
Covered by Health Insurance										
No	43.3(13)	56.7(17)	100.0(30)	2.316	0.128	31.8(7)	68.2(15)	100.0(22)	0.333	0.564
Yes	28.2(24)	71.8(61)	100.0(85)			25.8(25)	74.2(72)	100.0(97)		
Household has electricity										
No	37.5(15)	62.5(25)	100.0(40)	0.420	0.517	39.2(20)	60.8(31)	100.0(51)	6.650	0.010
Yes	31.4(22)	68.6(48)	100.0(70)			17.9(12)	82.1(55)	100.0(67)		
Household has Radio										
No	38.2(26)	61.8(42)	100.0(68)	1.687	0.194	38.8(26)	61.2(41)	100.0(67)	10.714	0.001
Yes	26.2(11)	73.8(31)	100.0(42)			11.8(6)	88.2(45)	100.0(51)		
Household has television										
No	36.0(32)	64.0(57)	100.0(89)	1.123	0.289	36.5(31)	63.5(54)	100.0(85)	13.450	0.000
Yes	23.8(5)	76.2(16)	100.0(21)			3.0(1)	97.0(32)	100.0(33)		
Main roof material										
Metal sheet	29.1(25)	70.9(61)	100.0(86)	3.682	0.055	17.9(14)	82.1(64)	100.0(78)	10.840	0.004
Ceramic tiles	50.0(12)	50.0(12)	100.0(24)			46.2(18)	53.8(21)	100.0(39)		
Other						0.0(0)	100.0(1)	100.0(1)		
Frequency of using internet										
Not at all	33.0(33)	67.0(67)	100.0(100)	0.698	0.874	33.0(32)	67.0(65)	100.0(97)	9.506	0.023
Less than once a week	0.0(0)	100.0(1)	100.0(1)			0.0(0)	100.0(1)	100.0(1)		
At least once a week	25.0(2)	75.0(6)	100.0(8)			0.0(0)	100.0(5)	100.0(5)		
Almost every day	33.3(2)	66.7(4)	100.0(6)			0.0(0)	100.0(15)	100.0(15)		
Frequency of watching television										
Not at all	39.0(30)	61.0(47)	100.0(77)	6.004	0.050	42.9(21)	57.1(28)	100.0(49)	14.866	0.001
Less than once a week	10.5(2)	89.5(17)	100.0(19)			25.7(9)	74.3(26)	100.0(35)		
At least once a week	26.3(5)	73.7(14)	100.0(19)			5.7(2)	94.3(33)	100.0(35)		
Frequency of listening to radio										
Not at all	50.0(13)	50.0(13)	100.0(26)	6.296	0.043	33.8(8)	66.7(16)	100.0(24)	2.294	0.318



Less than once a week	40.0(6)	60.0(9)	100.0(15)				36.4(8)	63.6(14)	100.0(22)		
At least once a week	24.3(18)	75.7(56)	100.0(74)				22.2(16)	77.8(56)	100.0(72)		
Type of cooking fuel											
Electricity + LGP/Natural gas	33.3(1)	66.7(2)	100.0(3)	4.584	0.205	0.0(0)	100.0(14)	100.0(14)	12.192	0.007	
Charcoal	22.9(11)	77.1(37)	100.0(48)				15.6(5)	84.4(27)	100.0(32)		
Wood	40.6(13)	59.4(19)	100.0(32)				35.5(22)	64.5(40)	100.0(62)		
Straw/Shrubs/grass	44.4(12)	55.6(15)	100.0(27)				50.0(5)	50.0(5)	100.0(10)		
Owns a mobile phone											
No	37.3(22)	62.7(37)	100.0(59)	1.452	0.228	37.3(22)	62.7(37)	100.0(59)	6.435	0.011	
Yes	26.8(15)	73.2(41)	100.0(56)			16.7(10)	83.3(50)	100.0(60)			
Use of internet											
Never	33.0(32)	67.0(65)	100.0(97)	0.985	0.611	34.4(32)	65.6(61)	100.0(93)	12.237	0.002	
Yes, last 12 months	31.3(5)	68.8(11)	100.0(16)			0.0(0)	100.0(23)	100.0(23)			
yes, before last 12 months	0.0(0)	100.0(2)	100.0(2)			0.0(0)	100.0(3)	100.0(3)			
Frequency of using internet last month											
Not at all	33.0(33)	67.0(67)	100.0(100)	0.698	0.874	32.7(32)	67.3(66)	100.0(98)	9.379	0.025	
Less than once a week	0.0(0)	100.0(1)	100.0(1)			0.0(0)	100.0(1)	100.0(1)			
At least once a week	25.0(2)	75.0(6)	100.0(8)			0.0(0)	100.0(5)	100.0(5)			
Almost every day	33.3(2)	66.7(4)	100.0(6)			0.0(0)	100.0(15)	100.0(15)			

**Table 8:** Multivariate Analysis: Stunting and Socio economic characteristics of the study population.

Variables	Intervention group									Control group								
	Yes %(n)	No %(n)	Total %(n)	COR	CI at 95%	p-value	AOR	CI at 95%	p-value	Yes %(n)	No %(n)	Total %(n)	COR	CI at 95%	p-value	AOR	CI at 95%	p-value
Wealth index																		
Poor	50.0(16)	50.0(16)	100.0(32)	3.125	1.280-7.631	0.012	2.673	1.066-6.702	0.036	41.3(19)	58.7(27)	100.0(46)	5.228	1.955-13.976	0.001	1.582	0.175-14.280	0.683
Middle	29.4(5)	70.6(12)	100.0(17)	1.302	0.398-4.261	0.663	1.224	0.365-4.107	0.743	42.9(6)	57.1(8)	100.0(14)	5.571	1.488-20.862	0.011	2.480	0.359-17.148	0.357
Rich	24.2(16)	75.8(50)	100.0(66)	1			1			11.9(7)	88.1(52)	100.0(59)	1			1		
Household has electricity																		
No										39.2(20)	60.8(31)	100.0(51)	2.957	1.276-6.851	0.011	0.313	.064-1.530	0.151
Yes										17.9(12)	82.1(55)	100.0(67)	1			1		
Household has Radio																		
No										38.8(26)	61.2(41)	100.0(67)	4.756	1.779-12.715	0.002	2.805	0.749-10.503	0.126
Yes										11.8(6)	88.2(45)	100.0(51)	1			1		
Household has television																		
No										36.5(31)	63.5(54)	100.0(85)	18.370	2.392-141.105	0.005	2.680	0.195-36.803	0.461
Yes										3.0(1)	97.0(32)	100.0(33)	1			1		
Main roof material																		
Metal sheet										17.9(14)	82.1(64)	100.0(78)	1			1		
Ceramic tiles										46.2(18)	53.8(21)	100.0(39)	3.918	1.667-9.212	0.002	2.682	0.804-8.945	0.109
Other										0.0(0)	100.0(1)	100.0(1)	0.000	0.000-1.000	1.000	0.000	0.000-1.000	
Frequency of using internet last month																		
Not at all										33.0(32)	67.0(65)	100.0(97)	1					
Less than once a week										0.0(0)	100.0(1)	100.0(1)	0.000	0.000-1.000	1.000			



At least once a week										0.0(0)	100.0(5)	100.0(5)	0.000	0.000-	0.999			
Almost every day										0.0(0)	100.0(15)	100.0(15)	0.000	0.000-	0.998			
Frequency of watching television																		
Not at all										42.9(21)	57.1(28)	100.0(49)	12.375	2.665-57.456	0.001	3.331	0.469-23.632	0.229
Less than once a week										25.7(9)	74.3(26)	100.0(35)	5.712	1.135-28.748	0.035	1.669	0.225-12.337	0.616
At least once a week										5.7(2)	94.3(33)	100.0(35)	1			1		
Frequency of listening to radio																		
Not at all										50.0(13)	50.0(13)	100.0(26)	3.111	1.222-7.919	0.017	2.639	1.066-6.923	0.049
Less than once a week										40.0(6)	60.0(9)	100.0(15)	2.074	0.649-6.626	0.218	1.895	0.576-6.235	0.293
At least once a week										24.3(18)	75.7(56)	100.0(74)	1			1		
Type of cooking fuel																		
Charcoal										15.6(5)	84.4(27)	100.0(32)	1			1		
Electricity + LGP/Natural gas										0.0(0)	100.0(14)	100.0(14)	0.000	0.000-	0.999	0.000	0.000	0.999
Wood										35.5(22)	64.5(40)	100.0(62)	2.970	1.002-8.806	0.050	1.38	0.223-8.507	0.731
Straw/Shrubs/grass										50.0(5)	50.0(5)	100.0(10)	5.540	1.130-25.809	0.035	3.02	0.292-32.291	0.353
Owns a mobile phone																		
No										37.3(22)	62.7(37)	100.0(59)	2.973	1.258-7.025	0.013	0.95	0.313-2.880	0.926
Yes										16.7(10)	83.3(50)	100.0(60)	1			1		
Use of internet																		
Never										34.4(32)	65.6(61)	100.0(93)	1					
Yes, last 12 months										0.0(0)	100.0(23)	100.0(23)	0.000	0.000-	0.998			
yes, before last 12 months										0.0(0)	100.0(3)	100.0(3)	0.000	0.000-	0.999			
Frequency of using internet last month																		
Not at all										32.7(32)	67.3(66)	100.0(98)	1					
Less than once a week										0.0(0)	100.0(1)	100.0(1)	0.000	0.000-	1.000			
At least once a week										0.0(0)	100.0(5)	100.0(5)	0.000	0.000-	0.999			
Almost every day										0.0(0)	100.0(15)	100.0(15)	0.000	0.000-	0.998			

COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio; CI: 95% Confidence Interval

**Control group:** No variable was found significant in multivariate analysis.

### Stunting and nutrition intervention components towards the study population

a) **Bivariate in intervention and control groups:** As shown in Table 9, the following variables were significant ( $p < 0.05$ ):

- **In intervention group:** Duration of breastfeeding, months of breastfeeding, did eat any solid, semi-solid or soft foods yesterday, drugs for intestinal parasites in last 6 months, given multiple micronutrient powder in the last 7 days.
- **In control group:** Given multiple micronutrient powder in the last 7 days, participated in monthly growth monitoring and nutrition promotion sessions, source

of drinking water, beating justified if wife goes out without telling husband.

b) **Multivariate analysis: Factors associated with stunting in intervention and control groups:** Table 10 displays the final results in multivariate analysis for the intervention group and the control group:

**Intervention group:** Children not currently breastfed and never breastfed were 39 times more likely to be stunted (AOR = 39.57, CI at 95% [1.369 - 1143.811],  $p$  - value = 0.032) compared to children breastfed between 0 and 6 months.

**Control group:** Children who received multiple micronutrient powder in the last 7 days were almost 5 times more likely to be stunted (AOR = 4.680, CI at 95% [1.366 - 16.036],  $p$  - value = 0.014) compared to children who did not receive multiple micronutrient powder; children from households where beating wife was justified if she goes out


**Table 9:** Bivariate analysis: Stunting and nutrition intervention components towards the study population.

Variables	Intervention group					Control group				
	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value	Yes %(n)	No %(n)	Total %(n)	$\chi^2$	p-value
Currently child breastfed										
No	75.0(3)	25.0(1)	100.0(4)	3.483	0.062	33.3(3)	66.7(6)	100.0(9)	0.206	0.650
Yes	30.6(34)	69.4(77)	100.0(111)			26.4(29)	73.6(81)	100.0(110)		
Child put to breast within one hour										
Yes	30.5(29)	69.5(66)	100.0(95)	0.092	0.762	25.3(25)	74.7(74)	100.0(99)	0.000	0.985
No	26.7(4)	73.3(11)	100.0(15)			25.0(3)	75.0(9)	100.0(12)		
Duration of breastfeeding										
Ever breastfed, not currently breastfeeding	100.0(7)	0.0(0)	100.0(7)	16.070	0.000	38.5(5)	61.5(8)	100.0(13)	1.618	0.445
Never breastfed	0.0(0)	100.0(1)	100.0(1)			50.0(1)	50.0(1)	100.0(2)		
Still breastfeeding	28.0(30)	72.0(77)	100.0(107)			25.0(26)	75.0(78)	100.0(104)		
Months of breastfeeding										
0-6	9.1(3)	90.9(30)	100.0(33)	28.003	0.000	25.0(8)	75.0(24)	100.0(32)	1.945	0.584
7-12	17.2(5)	82.8(24)	100.0(29)			21.2(7)	78.8(26)	100.0(33)		
13-24	48.9(22)	51.1(23)	100.0(45)			28.2(11)	71.8(28)	100.0(39)		
Not currently breastfed and never breastfed	87.5(7)	12.5(1)	100.0(8)			40.0(6)	60.0(9)	100.0(15)		
Drank from bottle with nipple yesterday/last night										
Yes	20.0(2)	80.0(8)	100.0(10)	0.744	0.388	18.8(3)	81.3(13)	100.0(16)	0.623	0.430
No	33.3(35)	66.7(70)	100.0(105)			28.2(29)	71.8(74)	100.0(103)		
Did eat any solid, semi-solid or soft foods yesterday										
Yes	36.3(29)	63.7(51)	100.0(80)	6.887	0.009	26.9(21)	73.1(57)	100.0(78)	0.043	0.835
No	10.3(3)	89.7(26)	100.0(29)			25.0(8)	75.0(24)	100.0(32)		
Number of times ate solid, semi-solid or soft food yesterday										
0-2	24.7(18)	75.3(55)	100.0(73)	2.671	0.102	29.2(26)	70.8(63)	100.0(89)	1.950	0.163
3 and more	40.0(14)	60.0(21)	100.0(35)			14.3(3)	85.7(18)	100.0(21)		
Given child anything other than breast milk										
Yes	28.6(2)	71.4(5)	100.0(7)	0.007	0.932	16.7(1)	83.3(5)	100.0(6)	0.246	0.620
No	30.1(31)	69.9(72)	100.0(103)			25.7(27)	74.3(78)	100.0(105)		
Vitamin A in last 6 months										
Yes	38.1(24)	61.9(39)	100.0(63)	2.239	0.135	27.1(19)	72.9(51)	100.0(70)	0.005	0.941
No	25.0(13)	75.0(39)	100.0(52)			26.5(13)	73.5(36)	100.0(49)		
Drugs for intestinal parasites in last 6 months										
Yes	44.0(22)	56.0(28)	100.0(50)	5.669	0.017	30.0(15)	70.0(35)	100.0(50)	0.424	0.515
No	23.1(15)	76.9(50)	100.0(65)			24.6(17)	75.4(52)	100.0(69)		
In the last 7 days given: local name for multiple micronutrient powder										
Yes	62.5(10)	37.5(6)	100.0(16)	7.833	0.005	62.5(10)	37.5(6)	100.0(16)	11.923	0.001
No	27.3(27)	72.7(72)	100.0(99)			21.4(22)	78.6(81)	100.0(103)		
Given zinc										
Yes	44.4(4)	55.6(5)	100.0(9)	0.006	0.940	50.0(3)	50.0(3)	100.0(6)	0.672	0.412
No	42.9(6)	57.1(8)	100.0(14)			31.6(6)	68.4(13)	100.0(19)		
Participated in monthly growth monitoring and nutrition promotion sessions										
Yes	40.7(11)	59.3(16)	100.0(27)	1.289	0.256	42.9(18)	57.1(24)	100.0(42)	7.686	0.006
No	29.1(25)	70.9(61)	100.0(86)			18.9(14)	81.1(60)	100.0(74)		
Source of drinking water										
Piped of all kind + bottled water	17.4(4)	82.6(19)	100.0(23)	7.284	0.063	3.7(1)	96.3(26)	100.0(27)	9.782	0.021
Public tap/standpipe	29.5(13)	70.5(31)	100.0(44)			34.8(8)	65.2(15)	100.0(23)		
Protected well and protected spring	41.9(13)	58.1(18)	100.0(31)			33.3(20)	66.7(40)	100.0(60)		



Unprotected spring, river/dam/lake /rainwater/ cart with small tank	58.3(7)	41.7(5)	100.0(12)			37.5(3)	62.5(5)	100.0(8)		
Type of toilet										
Flush toilet of all kind	28.6(2)	71.4(5)	100.0(7)	0.086	0.958	7.7(1)	92.3(12)	100.0(13)	3.235	0.198
Pit toilet of all kind	34.0(34)	66.0(66)	100.0(100)			29.8(31)	70.2(73)	100.0(104)		
No facility/bush /field	33.3(1)	66.7(2)	100.0(3)			0.0(0)	100.0(1)	100.0(1)		
Toilet facility shared with others										
Yes	24.4(11)	75.6(34)	100.0(45)	2.945	0.086	20.6(7)	79.4(27)	100.0(34)	1.103	0.294
No	40.3(25)	59.7(37)	100.0(62)			30.1(25)	69.9(58)	100.0(83)		
Beating justified if wife argues with husband										
Yes	38.9(14)	61.1(22)	100.0(36)	1.083	0.298	32.3(10)	67.7(21)	100.0(31)	0.614	0.433
No	29.1(23)	70.9(56)	100.0(79)			25.0(22)	75.0(66)	100.0(88)		
Beating justified if wife refuses to have sex with husband										
Yes	34.4(11)	65.6(21)	100.0(32)	0.098	0.754	34.6(9)	65.4(17)	100.0(26)	1.010	0.315
No	31.3(26)	68.7(57)	100.0(83)			24.7(23)	75.3(70)	100.0(93)		
Beating justified if wife burns the food										
Yes	33.3(6)	66.7(12)	100.0(18)	0.013	0.909	25.0(5)	75.0(15)	100.0(20)	0.044	0.834
No	32.0(31)	68.0(66)	100.0(97)			27.3(27)	72.7(72)	100.0(99)		
Beating justified if wife goes out without telling husband										
Yes	29.3(12)	70.7(29)	100.0(41)	0.247	0.620	42.9(15)	57.1(20)	100.0(35)	6.429	0.011
No	33.8(25)	66.2(49)	100.0(74)			20.2(17)	79.8(67)	100.0(84)		
Attend community parenting session in Education Community facility										
Yes	31.3(5)	68.8(11)	100.0(16)	0.007	0.932	37.5(6)	62.5(10)	100.0(16)	1.058	0.304
No	32.3(32)	67.7(67)	100.0(99)			25.2(26)	74.8(77)	100.0(103)		
Person who usually decides how to spend respondent's earnings										
Mother alone	40.0(6)	60.0(9)	100.0(15)	1.750	0.417	31.3(5)	68.8(11)	100.0(16)	0.723	0.697
Mother and husband/partner	22.6(7)	77.4(24)	100.0(31)			26.7(8)	73.3(22)	100.0(30)		
Husband/partner alone	37.5(3)	62.5(5)	100.0(8)			14.3(1)	85.7(6)	100.0(7)		
Person who usually decides on respondent's health care										
Mother alone	40.7(11)	59.3(16)	100.0(27)	2.402	0.493	25.0(8)	75.0(24)	100.0(32)	0.188	0.910
Mother and husband/partner	25.0(10)	75.0(30)	100.0(40)			28.6(14)	71.4(35)	100.0(49)		
Husband/partner alone	34.3(12)	65.7(23)	100.0(35)			30.0(6)	70.0(14)	100.0(20)		
Someone else	0.0(0)	100.0(1)	100.0(1)							

**Table 10:** Multivariate analysis: Stunting and nutrition interventions toward the study population.

Variables	Intervention group									Control group								
	Yes	No	Total	COR	CI at 95%	p-value	AOR	CI at 95%	p-value	Yes	No	Total	COR	CI at 95%	p-value	AOR	CI at 95%	p-value
	%(n)	%(n)	%(n)							%(n)	%(n)	%(n)						
Duration of breastfeeding																		
Ever breastfed, not currently breastfed																		
Ever breastfed, not currently breastfed	100.0(7)	0.0(0)	100.0(7)	4146385430	0.000-	0.999												
Never breastfed	0.0(0)	100.0(1)	100.0(1)	0.000	0.000	1.000												
Still breastfed	28.0(30)	72.0(77)	100.0(107)	1														
Months of breastfeeding																		
0-6	9.1(3)	90.9(30)	100.0(33)	1			1											
7-12	17.2(5)	82.8(24)	100.0(29)	2.083	0.452-9.609	0.347	2.518	0.194-32.689	0.480									
13-24	48.9(22)	51.1(23)	100.0(45)	9.565	2.548-35.912	0.001	8.796	0.543-142.550	0.126									



Not currently breastfed and never breastfed	87.5(7)	12.5(1)	100.0(8)	70.000	6.299-777.870	0.001	39.57	1.369-1143.811	0.032									
Did eat any solid, semi-solid or soft foods yesterday																		
No	10.3(3)	89.7(26)	100.0(29)	1			1											
Yes	36.3(29)	63.7(51)	100.0(80)	4.928	1.371-17.708	0.015	0.757	0.063-9.071	0.826									
Drugs for intestinal parasites in last 6 months																		
No	23.1(15)	76.9(50)	100.0(65)	1			1											
Yes	44.0(22)	56.0(28)	100.0(50)	2.619	1.173-5.846	0.019	1.061	0.332-3.389	0.920									
In the last 7 days given: local name for multiple micronutrient powder																		
No	27.3(27)	72.7(72)	100.0(99)	1			1			21.4(22)	78.6(81)	100.0(103)	1			1		
Yes	62.5(10)	37.5(6)	100.0(16)	4.444	1.473-13.413	0.008	3.350	0.915-12.266	0.068	62.5(10)	37.5(6)	100.0(16)	6.136	2.009-18.740	0.001	0.214	0.062-0.732	0.014
Participated in monthly growth monitoring and nutrition promotion sessions																		
No										18.9(14)	81.1(60)	100.0(74)	1			1		
Yes										42.9(18)	57.1(24)	100.0(42)	3.214	1.382-7.473	0.007	0.415	0.153-1.127	0.084
Source of drinking water																		
Piped of all kind + bottled water																		
										3.7(1)	96.3(26)	100.0(27)	1			1		
Public tap/standpipe																		
										34.8(8)	65.2(15)	100.0(23)	13.87	1.577-121.913	0.018	6.444	0.683-60.802	0.104
Protected well and protected spring																		
										33.3(20)	66.7(40)	100.0(60)	13.000	1.643-102.834	0.015	4.851	0.542-43.393	0.158
Unprotected spring, river/dam/lake / rainwater/ cart with small tank																		
										37.5(3)	62.5(5)	100.0(8)	15.600	1.336-182.090	0.028	4.094	0.284-58.988	0.300
Beating justified if wife goes out without telling husband																		
No										20.2(17)	79.8(67)	100.0(84)	1			1		
Yes										42.9(15)	57.1(20)	100.0(35)	2.956	1.257-6.952	0.013	0.324	0.123-0.852	0.022

COR:Crude Odd Ratio; AOR: Adjusted Odd Ratio; CI:95% Confidence Interval

without telling husband were 3 times more likely to be stunted (AOR = 3.087, CI at 95% [1.174 - 8.122], *p* - value = 0.022 ) compared to children from households where beating wife was not justified if she goes out without telling husband.

### Summary of main results from multivariate analysis in intervention and control groups

Table 11 shows the summary of the main results from multivariate analysis in intervention and control groups:

**In intervention group:** Children from households with 2 births in last three years were 7 times more likely to be stunted (AOR = 7.471, CI at 95% [1.357 - 41.123], *p* - value = 0.021) compared to children from households with 1 birth in last three years; children aged 11-20 months were almost 9 times more likely to be stunted (AOR = 8.828, CI at 95% [2.217 - 35.158], *p* - value = 0.002) compared to children aged 0 - 10 months; children aged 21 months - 24 months were 113 times more likely to be stunted (AOR = 113.27, CI at 95% [13.047 - 983.417], *p* - value = 0.000) compared to children aged 0-10 months; children smaller in size than average were 16 times

more likely to be stunted ( AOR = 16.072, CI at 95% [1.768 - 146.065], *p* - value = 0.014) compared to children larger than average, children with average size were 5 times more likely to be stunted ( AOR = 5.018, CI at 95% [1.167 - 21.577], *p* - value = 0.030) compared to children larger than average; children from poor households were almost 3 times more likely to be stunted (AOR = 2.673, CI at 95% [1.066 - 6.702], *p* - value = 0.036) compared to children from rich households; children from non-radio listening households were almost 3 times more likely to be stunted (AOR = 2.639, CI at 95% [1.066 - 6.923], *p* - value = 0.049) compared to children from households with a frequency of listening to radio of at least once a week; children not currently breastfed and never breastfed were 39 times more likely to be stunted (AOR = 39.57, CI at 95% [1.369 - 1143.811], *p* - value = 0.032) compared to children breastfed between 0 and 6 months.

**In control group:** Children who received multiple micronutrient powder in the last 7 days were almost 5 times more likely to be stunted (AOR = 4.680, CI at 95% [1.366 - 16.036], *p* - value = 0.014) compared to children who did





**Table 11:** Summary of main results from multivariate analysis.

Intervention group										Control group								
Variables	Yes	No	Total	COR	CI at 95%	P-value	AOR	CI at 95%	p-value	Yes	No	Total	COR	CI at 95%	P-value	AOR	CI at 95%	p-value
	%(n)	%(n)	%(n)							%(n)	%(n)	%(n)						
Births in last three years																		
1	27.4(26)	72.6(69)	100.0(95)	1			1											
2	55.0(11)	45.0(9)	100.0(20)	3.244	1.206-8.727	0.020	7.471	1.357-41.123	0.021									
Child's age in months																		
0-10	14.0(8)	86.0(49)	100.0(57)	1			1											
11-20	40.0(18)	60.0(27)	100.0(45)	4.083	1.569-10.624	0.004	8.828	2.217-35.158	0.002									
21-24	84.6(11)	15.4(2)	100.0(13)	33.69	6.267-181.082	0.000	113.3	13.047-983.417	0.000									
Size of the child																		
Larger than average and very large	17.8(8)	82.2(37)	100.0(45)	1			1											
Average	33.3(18)	66.7(36)	100.0(54)	2.312	0.894-5.985	0.084	5.018	1.167-21.577	0.030									
Smaller than average and very small	73.3(11)	26.7(4)	100.0(15)	12.72	3.212-50.358	0.000	16.07	1.768-146.065	0.014									
Wealth index																		
Poor	50.0(16)	50.0(16)	100.0(32)	3.125	1.280-7.631	0.012	2.673	1.066-6.702	0.036									
Middle	29.4(5)	70.6(12)	100.0(17)	1.302	0.398-4.261	0.663	1.224	0.365-4.107	0.743									
Rich	24.2(16)	75.8(50)	100.0(66)	1			1											
Frequency of listening to radio																		
Not at all	50.0(13)	50.0(13)	100.0(26)	3.111	1.222-7.919	0.017	2.639	1.066-6.923	0.049									
Less than once a week	40.0(6)	60.0(9)	100.0(15)	2.074	0.649-6.626	0.218	1.895	0.576-6.235	0.293									
At least once a week	24.3(18)	75.7(56)	100.0(74)	1			1											
Months of breastfeeding																		
0-6	9.1(3)	90.9(30)	100.0(33)	1			1											
7-12	17.2(5)	82.8(24)	100.0(29)	2.083	0.452-9.609	0.347	2.518	0.194-32.689	0.480									
13-24	48.9(22)	51.1(23)	100.0(45)	9.565	2.548-35.912	0.001	8.796	0.543-142.550	0.126									
Not currently breastfeeding and never breastfed	87.5(7)	12.5(1)	100.0(8)	70.000	6.299-777.870	0.001	39.57	1.369-1143.811	0.032									
In the last 7 days given: local name for multiple micronutrient powder																		
No	27.3(27)	72.7(72)	100.0(99)	1			1			21.4(22)	78.6(81)	100.0(103)	1			1		
Yes	62.5(10)	37.5(6)	100.0(16)	4.444	1.473-13.413	0.008	3.350	0.915-12.266	0.068	62.5(10)	37.5(6)	100.0(16)	6.136	2.009-18.740	0.001	0.214	0.062-0.732	0.014
Beating justified if wife goes out without telling husband																		
No										20.2(17)	79.8(67)	100.0(84)	1			1		
Yes										42.9(15)	57.1(20)	100.0(35)	2.956	1.257-6.952	0.013	0.324	0.123-0.852	0.022

COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio; CI: 95% Confidence Interval

not receive multiple micronutrient powder; children from households where beating wife was justified if she goes out without telling husband were 3 times more likely to be stunted (AOR = 3.087, CI at 95% [1.174 - 8.122],  $p$  - value = 0.022 ) compared to children from households where beating wife was not justified if she goes out without telling husband.

### Effect of nutrition interventions on stunting

Nutrition intervention was considered as stunting explanatory variable as it is shown in Table 12. After adjusting for duration of breastfeeding, months of breastfeeding, did eat any solid, semi-solid or soft foods yesterday, drugs for intestinal parasites in last 6 months, given local name for multiple micronutrient powder in the last 7 days, there was no significant difference between stunting in intervention group compared to the control group (AOR = 1.206, 95% CI: 0.638 - 2.278,  $p$  - value = 0.564).

## Discussion

The objective of this study was to determine the prevalence rate of stunting children after birth until 24 months, to

interventions whereas combined components of the nutrition intervention have been used in this study. It was therefore expected to have a significant difference in stunting in favor of the intervention group in this study as it has been reported in some other similar studies combining many components of the nutrition intervention [5,12,13]. The inconsistency of these findings could be due to the small size of the sample due to the children's recode dataset incompleteness.

In the intervention group, stunting was found to be associated with births in the last three years, child's age, child's birth size, wealth index, frequency of listening to radio and months of breastfeeding.

In the control group, stunting was found to be associated with receiving multiple micronutrients in the last 7 days and beating justified if the wife goes without telling her husband.

Children in the intervention group from households with 2 births in the last three years were more likely to be stunted than children from households with 1 birth in the last three years. These expected findings are similar to previous studies such as studies conducted in Ethiopia and India where birth intervals of less than 12 months and 12 months - 23 months were associated with higher risks for stunting as compared to birth intervals of 24 months - 35 months [14,15]. Birth spacing might influence childhood undernutrition through its association with preterm births and low birth weight. If a pregnancy occurs too soon after the previous birth, the mother may not have recovered her nutritional status, which can contribute to preterm birth and low birth weight [16]. Likewise, children aged 11 months - 20 months and aged 21 months - 24 months were more likely to be stunted than children aged 0-10 months. This result is supported by other studies that demonstrated that stunting increases with age (lowest in the first 6 months of life and increases by the time children reach 18 months - 23 months) [17-23]. The high risk of stunting observed in old age may be due to inappropriate feeding practices as well as repeated infections [24]. Stunting in old-age children could also be explained by the fact that prolonged breastfeeding could lead to breastmilk addiction and refusal of other food resources [25]. It also has been found that children born smaller in size than average were more likely to be stunted than children born larger than average. These findings have also been found in other studies [22,26-30]. Small birth size may be a manifestation of conditions such as preterm birth, poor maternal nutrition, and illness during pregnancy which might cause restricted growth and development of children [31]. Small birth size is also associated with different childhood morbidities like diarrhea and acute febrile illnesses which may lead to stunting of children [32]. Again in the intervention group, the findings of this study revealed that children from poor households were more likely to be stunted than children from rich households, which is consistent with the findings of previous studies carried out in different developing countries [33-36]. It is clear that increased income improves dietary diversity, which in turn improves the nutrient intake and nutritional status of the children and the mother, and it will result in appropriate growth and development [37,38]. It

**Table 12:** Effect of nutrition interventions on stunting.

Group	Stunting, % (95% CI)	Unadjusted		Adjusted	
		OR(95% CI)	$p$ - value	OR(95% CI)	$p$ - value
Control	26.9(19.2 - 35.8)	1		1	
Intervention	32.2(23.8 - 41.5)	1.290(0.734 - 2.265)	0.376	1.206(0.638 - 2.278)	0.564

determine the factors associated with stunting and to assess the effect of nutrition specific and nutrition sensitive intervention package on stunting. The study compared an intervention group made up of mother- child pairs which has been exposed to nutrition intervention package and a comparison group that has not been exposed to this nutrition intervention package. The study analyzed data from the 2020 Demographic and Health Survey.

The prevalence of stunting for children aged 0 months - 24 months at the end of Gikuriro program was 32.2% in the intervention group and 26.9 % in the control group and there was no significant difference between the intervention and control group. Some similar studies have found a significantly lower stunting prevalence in intervention areas than in comparison areas. It is the case with research on maternal nutrition counseling in Bangladesh [8], the impact of an integrated community-based micronutrient and health program on stunting in Malawi during the first phase of this program [9], changes in childhood stunting and its determinants after 3 years of exposure to an integrated, multisector intervention in 9 sub-Saharan African countries [5]. However, other studies reported that nutrition interventions were ineffective in reducing stunting: studies carried out in Burkina Faso [10] and in regions such as South Asia are some examples [11]. However, it should be noted that in the above studies, only nutrition education and counseling were used as



also has been found that children from non-radio listening households were more likely to be stunted than children from households with a frequency of listening to the radio at least once a week. Similarities have been found in other studies [39,40]. Mass media advertisements provide information on health, nutrition, proper hygiene practice, proper child feeding practice, and overall knowledge about health, which may contribute to the reduction of the prevalence of stunting among children [39]. Children not currently breastfed and never breastfed were more likely to be stunted than children breastfed between 0 and 6 months. This result is comparable to the findings of a study conducted in Ethiopia where children who were exclusively breastfed for less than 6 months were more likely to develop stunting than children who were exclusively breastfed for the first 6 months [41]. Another study carried out in Zambia found that children who were not being breastfed at the time of the survey were more likely to be stunted compared to those who reported being breastfed [42]. Inappropriate timing for introducing some kinds of complementary food to a child may affect his/her nutritional status because his/her digestive and immune systems are not yet mature. Introducing supplements before earlier, especially under unhygienic conditions, could be an important cause of malnutrition [41].

Children in the control group who received multiple micronutrient powder in the last 7 days were more likely to be stunted compared to children who did not receive multiple micronutrient powder. This result is unexpected and inconsistent with a study conducted in Kisangani where it has been found that the use of multiple micronutrient powder showed some benefits in reducing stunting at short term [43]. But in some other studies, efforts towards reduction of stunting by using multiple micronutrient powder have succeeded in some countries, and in others, stunting rates have unfortunately remained largely high [44-46]. The inconsistency of this finding could be due to the small size of the sample due to children's recode dataset incompleteness as it has been explained previously. Children from households where beating wife was justified if she goes out without telling husband were more likely to be stunted than children from households where beating wife was not justified if she goes out without telling husband. This result is consistent with what was expected because children whose mothers are not exposed to physical violence should be less stunted than those exposed to physical violence as it has also been found in others studies such as studies conducted in India and in Rwanda [18,23].

According to this study, there was no statistical significance effect of integrated nutrition-specific and nutrition-sensitive intervention package on stunting as it was expected. The study's findings however, should be interpreted with caution due to its shortcomings, which include the use of end program evaluation only, and the fact that stunting trend between the baseline and the end line has not been evaluated. In addition to that, even though there was no targeted intervention in control group to address the issue of stunting, this problem could have been addressed through the implementation and intensification of government and local authority initiatives

and efforts, particularly in districts like Ngororero where stunting rates are particularly high. As local authority initiatives, following are for example some measures established by Ngororero District to ensure it is not left behind in fighting against stunting : teams of people put in place to approach families that have malnourished children and give them practical advice concerning preparation of a balanced diet, assisting large families by lending them money to pay for health insurance ,advising younger families on how to avoid domestic violence, program aimed at sensitizing citizens to maintain hygiene in their communities [47]. Such efforts complement those carried out by the government as outlined in National Food and Nutrition Policy like GIRINKA (the one-cow-per-poor-family) program, one cup of milk per child, provision of subsidized fertilizer and free seed as part the crop intensification, promotion of improved kitchen garden and small livestock to improve micronutrients and national level 1st 1000 Days Campaign [48].

Based on the aforementioned factors, this study's finding (effect of nutrition intervention package on stunting) could be explained by stunting reduction in control group but not necessarily because of integrated nutrition-specific and nutrition-sensitive intervention package did not reduce stunting in intervention group.

### Strengths of the study

Using of population -based data with standardized tools and appropriate methodology including sample design and statistical analysis.

### Limitations of the study

Since it was a secondary data used, limitations in this study's data collection and analysis have been observed, such as some missing information and small size sample.

### Ethical considerations

The data used in this study are based on secondary data downloaded from Rwanda Demographic and Health Survey (RDHS) 2019 - 2020. A request to access RDHS 2019 - 2020 dataset has been received online.

### Conclusion

The findings of this study have shown that there was no significant difference in stunting between intervention and control group. In addition, stunting was not statistically decreased by integrated nutrition- specific and nutrition - sensitive intervention package as outlined in the study. However, since only end program was considered, and trend between the baseline and the end line has not been evaluated, and additionally, because of some particular initiatives put in place aiming at reducing stunting in the control group, it is advised to conduct a second study that takes into account all of the aforementioned factors before deciding whether to scale up nutrition-specific and nutrition-sensitive programs aimed at reducing stunting. Along with in this study, determinants



of stunting have been discovered in intervention and control groups which may assist policymakers for addressing this important health problem.

## Recommendations

In intervention group, this study revealed that children from households with 2 births in last three years, children aged more than 11 months, children with smaller and average size, children living in poor households, children from households non-radio listening, children not currently breastfed and never breastfed were more likely to be stunted than their counterparts. Thus, as recommendations, efforts should be made to encourage women to space births through strengthening the promotion and use of different family planning methods; to improve the nutrition status of children aged more than 11 months through nutrition education about the consumption of a diversified diet; to improve maternal nutrition during pregnancy in order to prevent small birth size; to improve households' wealth status by creating different income generating activities and to promote radio listening and breastfeeding. In control group, this study revealed that children from households where beating wife was justified if she goes out without telling husband were more likely to be stunted than their counterparts. As recommendation, effort is required to curb Intimate Partner Violence against women by strengthening policies, programs, and laws aiming at protecting them.

## Authors' contribution

Marc HABINEZA: conception of the work, design of the work, data collection supervision, data analysis, and interpretation, drafted manuscript. Maryse UMUGWANEZA and Laurence RUGEMA: provided critical comments on the paper. Cyprien MUNYANSHONGORE: overall supervision, conceptualization, methodology review and manuscript review. All authors have read and approved the manuscript for publication.

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## Data availability

For scientific purpose, data will be requested through the following email address: [habinezam@asome.health](mailto:habinezam@asome.health)

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