



Determinants of Undernutrition among Children under Age 5 in the Puntland State of Somalia

Dr. Abdi Mohamoud Ali^{a*}, Mr. Abdinasir Ali Dahir^b, Mr. Mohamed Said
Bashir^c

^aPrincipal Statistician at Somalia National Bureau of Statistics

*^{b,c}Statistician at Department of Statistics, Ministry of Planning, Economic Development and International
Cooperation, Puntland, Somalia*

^aEmail: huddun@gmail.com

^bEmail: boss9_2@hotmail.com

^cEmail: mdeero119@gmail.com

Abstract

The purpose of this study was to investigate the determinants of nutritional status among children under age 5 (0-59 months) in Puntland. Undernutrition is a global challenge, it does not only adversely affect short- and long-term health and economic well-being of children but it is also a leading contributor to death and disability globally. Undernutrition short-term effects include mortality and morbidity where long-term effects are that the children do not reach their full developmental potential and would have poor cognitive performance, which in turn has consequences on the country's economic productivity. Nutritional status of the Somali children in Puntland is relatively poor due to many reasons such as low economic conditions of Somali households, lack of food security and severe drought that has affected the country in recent years and among other factors. This study used data from the Puntland Health and Demographic Survey 2020 which was conducted by the Department of Statistics at Puntland Ministry of Planning, Economic Development, and International Cooperation with technical support from UNFPA Somalia. The analysis used stunting, wasting, and underweight as dependent variables, while the independent variables were children, maternal, and household characteristics. Bivariate and multivariate Logistic regression models were performed to analyze the determinants of nutritional status among the children.

* Corresponding author.

The study showed a significant association between children's nutritional status and most of the explanatory variables under study. Place of residence, gender of household head, wealth index, source of drinking water, source of energy for cooking, toilet facility, mother's age, marital status, education, breastfeeding, ANC visits, BMI, work status, child's sex, child's age, birth order and size at birth have significant associations with children's nutrition status. The study found that most variables in child, maternal, and household characteristics were significantly associated with stunting and wasting among children under age five. Based on these findings, the research recommends that a multi-sectoral approach is needed to address undernutrition in Puntland state. Combined nutrition programmes from different sectors in line with National Development Plans (NDP) need to be designed to address the underlying causes of acute and chronic malnutrition.

Keywords: Stunting; wasting; underweight; children under age 5; Health and Demographic Survey; Puntland.

1. Background

Undernutrition is a big challenge in Africa. It does not only adversely affects short- and long-term health and economic well-being of children but it is also a leading contributor to death and disability in the country. It is responsible for nearly half of the deaths in the globe for children less than 5 years of age, with a disproportionate burden in low-and-middle-income countries [1]. Undernutrition has both short- and long-term effects, its short-term effects include mortality and morbidity and its long-term effects are that the children do not reach their full developmental potential and would have poor cognitive performance, which in turn has consequences on the country's economic productivity [2]. Global reports showed that around 45% of child deaths in developing countries are due to under-nutrition [3].

Child growth is internationally recognized as an important indicator of nutritional status and health in populations. Underweight, wasting, and stunting indicators are usually used to measure nutritional imbalance resulting in undernutrition [4]

Nutritionists described that stunting or low height-for-age is a sign of chronic undernutrition that reflects a failure to receive adequate nutrition over a long period. Stunting can also be affected by recurrent and chronic illnesses. Wasting, or low weight-for-height, is a measure of acute undernutrition and represents the failure to receive adequate nutrition in the period immediately before the survey [4]. Wasting may result from inadequate food intake or from a recent episode of illness-causing weight loss. Underweight, or low weight-for-age, is a composite index of weight-for-height and height-for-age. Thus, it includes both acute (wasting) and chronic (stunting) undernutrition [5].

The nutritional status of the Somali children in Puntland is relatively poor due to many reasons such as low economic conditions of Somali households, and severe drought that has affected the country in recent years and among other factors [6]

In Puntland Health and Demographic Survey 2020 (PLHDS 2020), the height and weight measurements of children below 5 years were taken in addition to the inquiry of their dietary intake. The weight and height of the children that were taken were used as anthropometric measurements by using the Z-score. As WHO standards

show, indicators such as height for age, weight for height, and weight for age or stunting, can be used to calculate the nutritional status of children under five [3, 7].

1.1 Scope and limitation of the study

This study was designed to examine factors associated with stunting, wasting and underweight among children under-five who live in five regions of Puntland state using PLHDS 2020 data. As a limitation, this study did not include dietary intake and biochemical data to assess nutritional status of children. The findings will provide necessary evidence to policymakers and other stakeholders responsible for the health and nutrition of children to develop tailored policies and interventions aimed at improving the nutrition and wellbeing of the children in the state.

1.2 Objective

To investigate the determinants of undernutrition among children aged 0-59 months in Puntland using data from PLHDS 2020 in order to help inform better targeting of nutritional interventions.

1.3 Questions to be answered by the study

- 1) What are the determinants of undernutrition among children under age 5 in Puntland State of Somalia?
- 2) Which of these determinants imply signs of chronic undernutrition that reflects a failure to receive adequate nutrition over a long period and which of these factors are signs of acute undernutrition/temporary undernourishment?
- 3) Which of these determinants are amenable to policy intervention?

2. Literature Review

Ten reports and papers on child nutrition literature were identified as suitable for inclusion of the review; the publication of these papers ranges from the year 1997 to 2020 and covers mainly Somalia and countries in East Africa and Asia.

In Puntland Health and Demographic Survey (PLHDS 2020), children's height/length, weight, and age data were used to calculate three indices: height-for-age, weight for- height, and weight-for-age. The report shows the nutritional status of children under-five years according to three anthropometric indices - height for age, weight for height and weight for age. Overall, 25 percent of children under the age of five were stunted, 16 percent were severely stunted, 11 percent are wasted, 6 percent are severely wasted, 25 percent are underweight, and 15 percent are severely underweight [8].

According to the results of the post-Deyr 2016 Food Security and Nutrition Analysis Unit (FSNAU) seasonal assessment, the burden of acute malnutrition among children under the age of 5 was 944,000 cases, including 185,000 who are severely malnourished [9]. Amongst the worst affected population groups are internally displaced persons (IDPs) for whom the situation remains critical across the country [9, 6]. While evidence

shows that boys are more malnourished than girls, the reason for this disparity is unknown [6]. Severely malnourished children carry a high mortality risk and require lifesaving therapeutic nutritional support [10]

As of February 29th, 2020, the nutrition cluster partners reached 48,144 boys and 56,756 girls aged 06-59 months covering 13% HRP (Humanitarian Response Plans) targets in Puntland State of Somalia. Of which 38,602 are severely acute malnourished children, moderately acute malnourished children and PLW (Pregnant and Lactating Women) admitted were 66,298 and 21,201. To effectively, reduce rates of acute malnutrition it is vital to protect vulnerable households and build resilience to minor shock & alleviate economic hardship by preserving limited assets. Mitigating levels of acute malnutrition through preventative programs to circumvent malnutrition through early action interventions to those most at risk are critical to success [11].

In the Somali Region of Ethiopia, the overall prevalence of stunting, underweight and wasting were 33.4 %, 24.5 %, and 20 %, respectively. The main associated factors of stunting and wasting were family size, child's sex, and monthly income of the households. Immunization status was the only variable associated with all forms of malnutrition. Non-immunized children were 2.5 times more likely to become underweight than their counterparts. The prevalence of stunting was 3.8 times higher in households with large family size. Female children were 1.5 times more likely to become wasted than their counterparts [12].

The estimated national prevalence of wasting, stunting and low mid-upper arm circumference in children aged 6-59 months was 21 %, 31 %, and 36 %, respectively. Although fever, diarrhea, sex and age of the child, household size and access to foods were significant predictors of malnutrition, the strongest association was observed between all three indicators of malnutrition and the enhanced vegetation index. A 1-unit increase in enhanced vegetation index was associated with a 38 %, 49 % and 59 % reduction in wasting, stunting and low mid-upper arm circumference, respectively [13].

Infection and climatic variations are likely to be key drivers of malnutrition in Somalia. Better health data and close monitoring and forecasting of droughts may provide valuable information for nutritional intervention planning in Somalia [13].

The children's nutritional status is more sensitive to factors such as feeding/weaning practices, care, and exposure to infection at specific ages [14]. A cumulative indicator of growth retardation (height-for-age) in children is positively associated with age [15]. The presence of an intergenerational link between maternal and child nutrition means a small mother will have small babies who in turn grow to become small mothers. Some findings on the relationship between maternal and child nutrition [16, 17]. showed that a high proportion of low-birth-weight and stunted children were observed among malnourished mothers.

Determinants of childhood malnutrition can be divided into three levels of causality: immediate, underlying, and basic. Immediate causes are dietary and health status, which are influenced by food security, the level of health care available to mothers, and environmental health quality. Among the underlying factors, women's education and employment were said to be crucial. Finally, the most important basic factor is per capita national income [18].

Access to foods with high protein content and vegetation cover, a proxy of rainfall or drought, was associated with a lower risk of wasting and stunting. Age, gender, illness, access to carbohydrates and temperature were correlates of all three indicators. The spatial co-distribution was highest between stunting and underweight with relative risk values ranging between 0.15 and 6.20, followed by wasting and underweight (range: 0.18-5.18) and lowest between wasting and stunting (range: 0.26-4.32). Although nutrition response in Somalia has traditionally focused on wasting rather than stunting, integrated programming and interventions can effectively target both conditions to alleviate common risk factors [19].

A Systematic Review on Stunting, Wasting and Underweight in Sub-Saharan Africa revealed that the most consistent factors associated with childhood stunting, wasting and underweight in SSA were: low mother's education, increasing child's age, sex of child (male), wealth index/SES (poor household), prolonged duration of breastfeeding (>12 months), low birth weight, mother's age (<20 years), source of drinking water (unimproved), low mother's BMI (<18.5), birth size (small), diarrhea episode, low father's education and place of residence (rural). The factors that predispose a child to undernutrition are multi-sectoral. To yield a sustainable improvement in child nutrition in SSA, a holistic multi-strategy community-based approach is needed that targets the factors associated with undernutrition, thereby setting the region on the path to achieving the WHO global nutrition target by 2025 [20].

Children undernutrition had significantly associated mother's BMI with child's underweight status. Children whose mothers had no education were more likely to be wasted (AOR = 3.61, 95%CI 1.33-9.82). The study suggests that most of the analysed factors that accounted for malnutrition in Pakistani children (such as mother's age at marriage, educational level and mothers' nutritional status) are preventable [21]. Therefore, to reduce the burden of malnutrition interventions that can address these factors are required such as community-based education and targeted nutritional interventions [22].

3. Methodology

3.1 Data

This study used data from the Puntland Health and Demographic Survey 2020 which was conducted by the Department of Statistics at Puntland Ministry of Planning, Economic development and International Cooperation with financial and technical support from UNFPA Somalia. The PLHDS 2020 had collected representative data from Somali population in five pre-war regions (regions that existed before 1991) in the Puntland State of Somalia. For this paper, the analysis only included children aged 0-59 months with anthropometry data. A sample of 5,197 children were included in the analysis. Missing and inconsistent values for height and weight in the dataset were imputed. Sample weights were applied in all analyses due to the two-stage cluster sampling design used in the PLHDS.

3.2 Variables

3.2.1 Dependent variables

The anthropometric indicators used in this study to assess malnutrition in Somali children in Puntland State of Somalia are the ones defined by WHO (2006) as a child growth standard and they are stunting (low height-for-age); underweight (low weight-for-age); and wasting (low weight-for height [3, 7]).

In terms of height-for-age, a child is classified as stunted if she or he is 2 standard deviations below the median (-2SD) of the World Health Organization reference population [3, 7]. For weight-for-age, if a child is 2 standard deviations below (-2SD) the reference median, she or he is considered as wasted and child is categorized as underweight if his or her weight-for-age is lower than 2 standard deviations (-2SD) from the median of the reference population [3, 7].

3.2.2 Independent variables

To analyze the determinants of nutritional status among children under age 5, the study considered the following characteristics as independent variables:

Household-level variables (place of residence, region, gender of household head and wealth index, source of energy for cooking, source of drinking and toilet facility). Maternal level variables (Age, marital status, education, ANC visit, BMI and employment status).

Child level variables (Sex, age, birth order, size at birth breastfeeding and preceding birth Interval).

3.2.3 Statistical analysis

Bivariate and Logistic regression analyses were performed using Stata version 15.1 to analyse the association between undernutrition and independent factors mentioned above. Firstly, bivariate analysis was used to analyze the association between the dependent and independent variables, then logistic regression model was fitted on the data to determine the effect of various variables on malnutrition. P-value less than 0.05 was considered as a significant association between the dependent and independent variables.

Bivariate analysis and logistic regression model were performed separately for the dependent variable on each of Household variables (Place of residence, region, gender of household head and wealth Index, main source of energy of cooking, Source of drinking water, Toilet facility). Maternal variables (Age at birth, marital status, education, ANC visit, and BMI and work status). Child variables (Sex, age, birth order and size at birth).

The odds ratio, which is determined from the logistic regression coefficients tells us the level of undernutrition given a set of the independent variable while controlling for the effects of the other variables in the model. Estimates of odds greater than 1.0 indicate that the risk of undernutrition is greater than that for the reference category. Estimates less than 1.0 indicate that the risk of undernutrition is less than that for the reference

category of each variable. Statistical significance of different factors has been decided considering the P- values.

4. Results

4.1 Bivariate Analysis of Determinants of Undernutrition by Background Characteristics

As can be seen in Table.1, Table.2 and Table.3, the bivariate analysis was performed using a chi-square (χ^2) test and results show a significant association between children's nutritional status and most of the explanatory variables under study.

Household Characteristics

The bivariate analysis shows that the prevalence of stunting was significantly higher among children in urban and rural areas with 28 percent and 33 percent respectively comparing with the children in the nomadic areas (16 percent).

The prevalence of underweight children was also highest in the urban and rural areas with 30 percent and 29 percent respectively compared with nomadic areas at 17 percent. The prevalence of children wasted was lowest in nomadic areas with 10 percent. Regionally, the highest prevalence of child stunting was observed in Bari region with 35 percent, followed by Sool and Sanaag with 25 percent and 24 percent respectively, while Nugaal has the lowest prevalence at 19 percent.

The bivariate analysis shows that the wealth index was significantly associated with child nutritional status. The prevalence of stunting, wasting and underweight was highest among the children from poor households with 30 percent, 16 percent and 25 percent respectively comparing to children from rich households. Children from households who use non-improved sources of drinking water were more likely to be wasted.

The prevalence of stunting and wasting among children of households with non-improved toilet facilities or no toilet facilities at all was significantly higher as compared to those with improved toilet facility. The bivariate analysis also shows that source of energy for cooking used by the households was significantly associated with child's nutritional status. Prevalence of underweight children was highest among children from households who uses Firewood and Charcoal with 31 percent and 30 percent respectively.

Child characteristics

For considering children's characteristics, the age of the child was found to be significantly associated with undernutrition. Prevalence of stunting was higher among the children aged 6-11 months, 24-59 months and those aged 12-17 months, where prevalence of wasting was also higher among those who aged 6-11 months. Gender wise, discrepancy in prevalence of underweight, stunting and wasting was not found as there was no significant difference in the prevalence among boys and girls.

Table 1: Bivariate analysis of Undernutrition by Household's Characteristics

Table 1: Bivariate analysis of undernutrition by Household Characteristics						
Independent variables	Dependent variables					
	Stunting %	P-value	Wasting	P-value	Underweight	P-value
Residence		0.000		0.000		0.000
Urban	27.9		8.8		30.4	
Rural	32.5		9.1		28.8	
Nomadic	16.4		15.1		16.8	
Region of residence		0.000		0.000		0.000
Sool	25.1		13.1		20.6	
Sanaag	23.8		14.5		19.2	
Bari	35.1		8.4		37.7	
Nugaal	19.1		13.8		10.6	
Mudug	21.3		9.1		26.8	
Wealth Status		0.000		0.000		0.000
Rich	19.5		9.2		23.5	
Middle	26.8		11.2		21.2	
Poor	30.3		16.2		24.9	
Sex of household head		0.814		0.108		0.036
Male	26.2		11.5		27.1	
Female	25.9		10.4		24.7	
Main source of energy for cooking		0.389		0.317		0.033
Electricity	24.6		10.5		20.5	
LPG	26.0		9.3		20.7	
Kerosene	26.6		5.3		23.3	
Firewood	25.4		11.5		30.5	
Charcoal	25.5		9.9		29.9	
Other solid fuels	20.2		13.2		22.0	
Toilet Facility		0.005		0.027		0.021
Improved Toilet Facility	22.8		10.6		25.2	
Non-Improved Toilet Facility	26.5		12.5		26.4	
No facility/Bush/Field	29.4		12.7		27.9	
Source of drinking water		0.033		0.004		0.042
improved source	26.0		10.9		25.8	
Non-Improved source	26.6		12.3		26.7	

Birth order of the child was not significantly associated with child nutritional status but children with low birth weights are more likely to be underweight.

The preceding birth interval of the child was also positively associated with children’s nutrition status. The highest proportion of stunted children were observed among those whose preceding birth interval was less than 24 months with 28 percent.

Table 2: Bivariate analysis of child variables and undernutrition

Table 2: Bivariate analysis of child variables and undernutrition						
Independent variables	Dependent variables					
	Stunting %	P-value	Wasting	P-value	Underweight	P-value
Child’s Age in Months		0.000		0.000		0.389
Less than 6 months	17.3		14.1		28.2	
6-11 months	24.8		16.9		25.2	
12-17 months	30.7		10.2		23.1	
18-23 months	24.1		8.6		20.9	
24-59 months	25.6		10.3		25.6	
Sex		0.445		0.562		0.681
Male	25.2		10.9		21.0	
Female	25.6		11.2		19.3	
Size at birth		0.076		0.009		0.049
Very small	17.1		15.4		18.9	
Small	30.3		12.0		29.4	
Average or larger	27.3		10.6		27.5	
Birth order		0.97		0.486		0.397
First	26.7		11.0		27.0	
2 to 4	26.6		10.9		26.0	
5 or higher	22.8		16.3		29.3	
Preceding birth Interval		0.016		0.041		0.366
<24 Months	28.3		11.1		29.6	
24 – 35 Months	26.8		10.4		24.7	
36 – 47 Months	26.5		12.3		26.7	
48 Months & More	26.3		10.1		26.6	

Mother's Characteristics

Moreover, it was also found that the likelihood of being undernourished was higher among children of mothers with no education compared to children whose mothers have some secondary or higher education. The

prevalence of children stunted was higher among children born to mothers without ANC visits with 29 percent. The analysis also shows that the mothers' employment status was significantly associated with child nutritional status. The prevalence of children stunted was highest among the children with employed mothers with 29 percent and the prevalence of children who are underweight was highest among the children with divorced and widowed mothers with 30 and 31 percent respectively.

Table 3: Bivariate analysis of maternal variables and undernutrition

Table 3: Bivariate analysis of maternal variables and undernutrition						
Independent variables	Dependent variables					
	Stunting %	P-value	Wastin g	P-value	Underweigh t	P-value
Current Marital Status		0.622		0.117		0.023
Married	26.0		11.4		25.6	
Divorced	28.5		10.4		29.7	
Widowed	25.3		5.9		30.5	
Mother's Nutritional Status		0.013		0.245		0.032
Thin (BMI < 18.5)	33.4		5.2		22.9	
Normal (BMI 18.5-24.9)	22.3		12.8		23.6	
Overweight/obese (BMI >= 25)	21.1		14.5		28.1	
Mother's educational level		0.006		0.001		0.242
No-education	26.5		11.2		25.4	
Primary	24.7		10.4		25.4	
Secondary or higher	20.4		9.2		19.7	
Mother's Age at Birth		0.049		0.045		0.008
<20	25.9		11.6		26.8	
20-34	27.0		11.1		26.8	
35-49	22.7		11.3		22.1	
ANC		0.004		0.007		0.003
Women with ANC for their recent birth	24.8		8.9		24.6	
Women without ANC for their recent birth	29.2		11.3		30.0	
Mother's Employment status		0.034		0.745		0.55
Employed	29.0		12.3		26.4	
Unemployed	26.0		11.1		26.0	

4.2 Multivariate analysis of Determinants of Undernutrition by Background Characteristics

As Table.4, Table.5 and table.6 show, multivariate analysis of logistic regression was performed to examine the

net effect of each independent variables household, child and maternal characteristics.

Household characteristics

Considering the characteristics of the household, the model showed that the sex of the household head, place and region of residence, toilet facility used, source of drinking water, source of cooking fuel, and wealth status are important predictors of nutrition status.

This model showed that children from households headed by females are less likely to be wasted compared with children from households headed by males.

Regarding water and sanitation facilities, the analysis shows that children in households with non-improved toilet facilities are 1.3 times more likely to be stunted and 1.5 times more likely to be wasted and children from households with no toilet facilities are 1.39 times more likely to be stunted and 1.4 times more likely to be wasted compared with children in households with improved toilet facility. Source of drinking water has also affected children’s nutrition as children from households with the non-Improved source of drinking water are 1.24 times more likely to be stunted and 1.15 times to be wasted compared to children from households that use an improved source of drinking water.

Furthermore, children from households who use traditional fuel types (firewood and charcoal) are more likely to be undernourished. Children from households who use firewood are 1.3 times more likely to be stunted and 1.4 times more likely to be wasted compared with children from households who use electricity as the main source of energy for cooking. Children whose families use charcoal are also 1.3 times more likely to be stunted and 1.94 times to be wasted compared with children from households who use electricity and LPG as main sources of energy for cooking. Household economic status is positively related with child nutrition status, the findings show that the risk of being stunted for children in poor households were 1.68 times more likely to be stunted compared with children from rich households. For the place of residence, the model shows that rural children are 1.24 times more likely to be stunted and children from nomadic areas are 1.84 times more likely to be wasted compared with children from households in urban areas. Region of residence was also associated with children’s nutritional status. Children in households in Bari and Sool regions had higher odds of being stunted compared with children in the Nugaal region, while children in households in the Bari and Mudug regions had the highest odds of being wasted.

Table 4: Odds Ratio of stunting, wasting and underweight among children aged 0-59 months by Household

Table 4: Odds Ratio of stunting, wasting and underweight among children aged 0-59 months by Household Characteristics			
Independent variables	Dependent variables		
	Stunting	Wasting	Underweight
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Place of residence			

Urban	1 ^R	1 ^R	1 ^R
Rural	1.24** (1.07 - 1.44)	1.04** (0.82 - 1.31)	0.93 (0.80 - 1.07)
Nomadic	0.51*** (0.35 - 0.43)	1.84** (1.50 - 2.27)	0.46** (0.40 - 0.54)
Wealth Status			
Rich	1 ^R	1 ^R	1 ^R
Middle	1.10** (0.89 - 1.34)	0.72* (0.53 - 0.99)	1.54* * (1.23 - 1.92)
Poor	1.68*** (0.55 - 0.83)	1.21* (0.91 - 1.62)	1.02 (0.82 - 1.27)
Region			
Nugaal	1 ^R	1 ^R	1 ^R
Sool	1.42** (1.10 - 1.84)	0.95 (0.69 - 1.29)	2.18*** (1.60 - 2.96)
Sanaag	1.32* (1.03 - 1.70)	1.06 (0.79 - 1.41)	2.00*** (1.48 - 2.70)
Bari	2.29*** (1.82 - 2.89)	0.57*** (0.42 - 0.78)	5.09*** (3.85 - 6.73)
Mudug	1.15* (0.91 - 1.45)	0.62*** (0.47 - 0.83)	3.07*** (2.33 - 4.05)
Source of Cooking Fuel			
Electricity	1 ^R	1 ^R	1 ^R
LPG	1.08** (0.57 - 2.04)	0.88 (0.35 - 2.20)	1.69 (0.88 - 3.25)
Kerosene	1.11** (0.48 - 2.58)	0.48 (1.07 - 2.11)	0.99 (0.40 - 2.46)
Firewood	1.35** (0.61 - 1.79)	1.4* (0.52 - 2.36)	1.16 (0.66 - 2.06)
Charcoal	1.3** (0.61 - 0.82)	1.94** (0.49 - 2.02)	1.64 (0.92 - 2.92)
other solid fuels	0.78 (0.37 - 1.65)	1.30 (0.49 - 3.45)	1.08 (0.50 - 2.33)
Source of Toilet Facility			
Improved toilet facility	1 ^R	1 ^R	1 ^R
Non-improved toilet facility	1.26* (0.92- 1.44)	1.5* (0.96 - 1.51)	0.94 (0.79 - 1.12)
No facility/ Bush/Field	1.39** (1.02 - 1.76)	1.4** (1.01 - 1.68)	1.08*8 (0.86 - 1.36)
Source of Drinking Water			
Improved source of drinking water	1 ^R	1 ^R	1 ^R
Non-improved source of drinking water	1.24** (0.88 - 1.22)	1.15*** (0.94 - 1.42)	1.04*** (0.90 - 1.22)
Sex of Household Head			
Male	1 ^R	1 ^R	1 ^R
Female	0.99 (0.86 - 1.14)	0.89 (0.73 - 1.09)	0.88** (0.77 - 1.02)
*** p<0.001, ** p<0.01, * p<0.05, OR: Odds Ratio, 1 ^R : Reference category			

Child Characteristics

The analysis shows that child’s age has a significant association with stunting. Children aged 6 to 11 months, Children aged 12 to 17 months, and those aged 24 to 59 months had the highest odds of being stunted, as they are 1.58, 2.12, and 165 times more likely to be stunted respectively compared to children aged 0-5 months. The risk of stunting was found to be 1.2 times higher for children of first birth order as compared with children of birth order four or more. Children who were small at birth (as reported by the mother) are more likely to be stunted, wasted, and underweight compared to those who were average in size at birth. This study also examined the association of breastfeeding and complementary feeding with children’s nutrition status. It was found that children who have been never Breastfed are 1.43 times more likely to be stunted and 1.26 times are more likely to be wasted compared to children who had been breastfed with complements. It was also observed that the preceding birth interval of the child has a significant association with the nutrition status. Children whose preceding birth interval was less than two years were 1.15 times more likely to be stunted, 1.28 times more likely to be wasted and 1.29 times more likely to be underweight as compared with children whose preceding birth interval was 48 months and more.

Table 5: Odds Ratio of stunting, wasting and underweight among children aged 0-59 months and child variables

Table 5: Odds Ratio of stunting, wasting and underweight among children aged 0-59 months by Child Characteristics			
Independent variables	Dependent variables		
	Stunting OR (95% CI)	Wasting OR (95% CI)	Underweight OR (95% CI)
Child Age			
Less than 6 months	1 ^R	1 ^R	1 ^R
6-11 months	1.58*** (1.14 - 2.19)	1.24 (0.86 - 1.77)	0.85 (0.63 - 1.15)
12-17 months	2.12*** (1.60 - 2.83)	0.69* (0.48 - 0.99)	0.76* (0.58 - 1.00)
18-23 months	1.52* (1.07 - 2.16)	0.57* (0.36 - 0.92)	0.67* (0.48 - 0.94)
24-59 months	1.65*** (1.29 - 2.12)	0.70** (0.53 - 0.92)	0.88 (0.71 - 1.08)
Birth Order			
5 or higher	1 ^R	1 ^R	1 ^R
2 to 4	1.23** (0.66 - 2.29)	0.63 (0.31 - 1.28)	0.85 (0.48 - 1.51)
First	1.24** (0.67- 2.30)	0.64 (0.31 - 1.30)	0.89 (0.50 - 1.59)
Preceding birth Interval			
48 Months & More	1 ^R	1 ^R	1 ^R
<24 Months	1.15** (0.87 – 1.22)	1.28** (0.94 – 1.75)	1.29* (0.96 – 1.87)
24 – 35 Months	1.09* (0.92 – 1.59)	1.03* (0.80 – 1.45)	0.91 (0.64 – 1.26)
36 – 47 Months	1.01* (0.86 – 1.42)	1.34** (0.97 – 2.56)	1.03 (0.82 – 1.22)
Breastfeeding and consuming other complements			
Breastfeeding and consuming other complements	1 ^R	1 ^R	1 ^R
Exclusive breastfeeding	1.01 (0.72 - 1.43)	1.19** (0.73 - 1.42)	0.94 (0.68 - 1.31)
Never breastfeed	1.43* (0.89 - 1.56)	1.26* (0.87 - 1.71)	0.88 (0.69 - 1.14)

*** p<0.001, ** p<0.01, * p<0.05, OR: Odds Ratio, 1^R: Reference category

Mother’s Characteristics

Regarding Mother’s characteristics, the likelihood of being stunted was found to be 1.48 times higher among children born to mothers with no education compared with children whose mothers have some secondary or

higher education. Children whose mothers have some primary educations are also 1.34 times more likely to be stunted compared to children whose mothers had some secondary or higher education. Mother’s marital status has shown significant association with children’s nutrition status as the children with divorced and widowed mothers were 1.22 and 1.27 times respectively more likely to be underweight compared to children with married mothers. The model showed that a mother’s age at birth has significantly associated with children’s nutrition status. Children born to mothers aged less than 20 years were 1.3 times more likely to be stunted and 1.3 times more likely to be underweight compared to children whose mothers aged 35-49 years. Children born to mothers aged less than 20-34 years were also 1.26 times more likely to be stunted and 1.22 times more likely to be underweight compared to children whose mothers aged 35-49 years.

Table 6: Odds Ratio of stunting, wasting and underweight among children aged 0-59 months by Mother's characteristics

Independent variables	Dependent variables		
	Stunting	Wasting	Underweight
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Mother's Nutritional Status			
Normal	1 ^R	1 ^R	1 ^R
Thin	1.44** (0.89 - 2.54)	0.42 (0.16 - 1.13)	0.77 (0.43 - 1.38)
Overweight	1.38* (0.81 - 2.32)	0.60 (0.32 - 1.14)	0.98 (0.64 - 1.48)
Mother's education			
Secondary & above	1 ^R	1 ^R	1 ^R
Primary Education	1.34** (1.01 - 1.77)	1.15*** (0.32 - 0.79)	1.38* (0.71 - 1.37)
No-education	1.48*** (1.13 - 1.93)	1.24** (0.52 - 1.13)	1.38* (0.71 - 1.37)
Age at Birth			
35-49	1 ^R	1 ^R	1 ^R
20-34	1.26** (1.05 - 1.51)	0.98 (0.77 - 1.25)	1.22** (1.02 - 1.56)
<20	1.30** (0.93 - 1.52)	1.03*** (0.84 - 1.43)	1.30* (1.12 - 1.65)
Marital Status			
Married	1 ^R	1 ^R	1 ^R
Divorced	1.13 (0.88 - 1.47)	0.90 (0.61 - 1.31)	1.22* (0.95 - 1.58)
Widowed	0.97 (0.64 - 1.45)	0.48 (0.23 - 1.02)	1.27** (1.04 - 1.68)
ANC			
Women with ANC for their most recent birth	1 ^R	1 ^R	1 ^R
Women without ANC for their most recent birth	1.38*** (0.97 - 1.52)	1.32** (0.99 - 1.87)	1.14*** (0.89 - 1.28)
Mother's Employment Status			
Employed	1 ^R	1 ^R	1 ^R
Unemployed	0.86** (0.67 - 1.12)	0.89 (0.62 - 1.26)	0.98 (0.75 - 1.27)

*** p<0.001, ** p<0.01, * p<0.05, OR: Odds Ratio, 1^R: Reference category

The odds of stunting, wasting and underweight among children whose mothers had no prenatal care visit are 1.32 times, 1.38 times and 1.14 times more likely to be stunted respectively compared with children whose mothers had prenatal care visits for their recent birth. According to the findings of this study, the mother's employment status has significantly associated with the risk of undernutrition for her children. The analysis shows that the children with employed mothers are more likely to be stunted compared with children whose mothers were unemployed. Children whose mothers were overweight or thin had higher odds of being stunted compared to children born to mothers with normal BMI. Children whose mothers were overweight or obese were also more likely to be wasted.

5. Discussion

The objective of the study was to identify and assess the determinants of undernutrition among children under age 5 in the Puntland State of Somalia. The result of the study shows a significant association between children's nutritional status and most of the explanatory variables in the study.

The study shows that children in households with non-improved water and poor sanitation facility are more likely to be malnourished compared to children from households that use an improved source of drinking water and improved toilet facility [23, 24]. That implies the unfavorable health environment caused by inadequate water and sanitation can increase the probability of infectious diseases and indirectly lead to certain types of malnutrition [25]. Other studies [26, 27] showed that unprotected water sources and non-availability of latrine were associated with low child stature. However, other observational studies have found little or no significant protective associations between access to improved water and anthropometric outcomes [28, 29].

Findings have also shown that children from households headed by females were less likely to be underweight compared to children from households headed by males. The finding is supported by a case study carried out in Kenya. indicated that when women have more control over resources, more goes to the children [30].

The majority of Puntland households use traditional fuels such as firewood, charcoal, and dung to meet their daily needs, and most households cook food inside and that affects children's health and well-being. This is consistent with [31], which found that indoor air pollution and smoking are causes of low birth weight and could possibly impact stunting. Another study in India reported that associations between air pollution and stunting [32].

The study revealed that household economic status is positively related to a child's nutrition status in Puntland. Children from poor households were more likely to be malnourished compared with children from rich households. This indicates the association of household economic status with household food security which is a prerequisite for access to adequate dietary intake for all members of the household in general and for children in particular. Small-scale studies [27, 17] undertaken in Ethiopia have also shown the importance of household economic status to improve stunting in children.

The study shows that children born to mothers with no education are more likely to be stunted compared with children whose mothers have some secondary or higher education. That implies that education is one of the

most important resources that enable women to provide appropriate care for their children. Studies done elsewhere indicated that a mother's education is an important determinant of children's growth and development [33]. Studies in various settings including Philippines [34]; Bolivia [35]; 1988), Kenya [36, 37]; and Ethiopia [16, 17] show a decreased incidence of malnutrition among young children with an increase in the level of mothers' education.

Although the mother's income generated from employment may raise a household's effective demand for food and another important dietary intake, the study showed that children of unemployed mothers were less likely to be stunted compared to children whose mothers were employed. That can be attributed to the fact that employment can reduce a mother's time for childcare. Some studies have shown that mothers with the most malnourished children work outside of their home [38, 39, 40] Another study argued that there is no significant association between maternal employment and children's nutritional status [41].

The odds of stunting, wasting and being underweight were higher among children whose mothers had no prenatal care visit during their pregnancy compared with children whose mothers had prenatal care visits for their recent birth [21]. That may be due to the fact that such mothers have poor health-seeking behavior and they are likely not to take appropriate actions to improve the health status of their children, which is an important component of child nutrition [42].

Maternal undernutrition is a persistent determinant of child undernutrition identified in this study. The study found that children whose mothers were thin (BMI <18.5) or overweight were more likely to be undernourished. At the same time, the likelihood of undernutrition significantly increased among children who were small at birth, demonstrating further the importance of maternal nutrition during pregnancy, which is known to significantly affect the nutrition of their children [43]. Optimum maternal nutrition before and during pregnancy is important for a healthy pregnancy outcome, as low maternal BMI is associated with intrauterine growth retardation [44, 45].

It was found that the birth order of the child is one of the demographic variables explaining the risk of stunting and wasting in children. Children of first birth order were found to be significantly at a higher risk of stunting than children of higher birth. This higher risk of stunting in first birth order children could be due to mothers' low level of experience at first delivery in the area of child care and feeding, which are important components of improved nutrition. This contradicts findings of other studies [46, 47] which found children with higher birth order are more likely to be stunted than children of first birth order.

For child's characteristics, the analysis shows that child's age had a significant association with stunting. Children aged 6 to 11 months, Children aged 12 to 17 months and those aged 24 to 59 months had the highest prevalence of stunting. This may be an indication of either inappropriate food supplementation in quantity and/or quality during the weaning period, or exposure to disease.

Children who were small at birth were more likely to be stunted, wasted, and underweight compared to those who were average in size at birth, and this may be due to the poor nutrition of mothers during pregnancy. This is

in line with study [48] children with Low birth weight had significantly increased risk of becoming malnourished compared to their counterpart.

Preceding interval birth has also affected the nutritional status of the children. Children whose preceding birth interval was less than two years were more likely to be undernourished. That could be due to fact that the previous child may be prematurely weaned if the mother becomes pregnant again too early or the mother herself may be biologically depleted from too frequent births.

6. Conclusion and Recommendation

The study identified the determinants of undernutrition among children under age 5 in the Puntland State of Somalia. It found that socioeconomic and demographic variables have a significant influence on the odds of malnutrition in children.

Based on these findings, the study recommends that a multi-sectoral approach is needed to address children's undernutrition in Puntland state. Combined nutrition programmes from different sectors in line with National Development Plans (NDP) should be designed to address the underlying causes of acute and chronic malnutrition contributing to the achievement of the Sustainable Development Goals (SDGs).

The health sector should provide basic nutrition services to build the resilience of mothers, caregivers and their communities to promote nutrition-seeking behaviour. They need to encourage positive behaviours toward childcare and infant feeding practices. Interventions should be focused on child health promotion to ensure children in Puntland receive adequate nutrition. Intervention should be also included the improvement of health and well-being of mothers with low BMI and special nutritional arrangements for children who have smaller size at birth, necessary vaccination for all children should be also promoted.

The education sector should provide maternal education to ensure mothers' awareness about child care and care practices including policies of health nutritional care of children in Puntland and to reduce cultural and gender barriers.

Furthermore, the Ministry of Health and Ministry of Public Works need to build and promote the use of improved toilets. To reduce stunting and wasting due to traditional fuel usage in households, the authority should avail affordable sources of energy to the poor households which can be an alternative to fuelwood. The water and energy sector should also help households to access an improved source of drinking water. Financial institutions need to improve household wealth status and food security.

Further research on dietary assessment and how climatic events affect children's nutrition status is suggested.

7. Authors' contributions

Dr. Abdi M Ali analyzed data and wrote the manuscript. Abdinasir Ali cleaned and prepared datasets for the study. Mohamed S. Bashir helped in analyzing data in Stata version 15.1.

Acknowledgments

This research was made possible by the UNFPA Somalia as it provided funds and other necessary supports to the study. We would like to express our special thanks to our colleagues at UNFPA; Mr. Felix Mulama, Mr. Richard Ngetich, and MS Zena Lyaga for their review and editorial assistance of this paper. We also appreciate the support of Ms. Mariam Alwi as her scholarly guidance and encouragement was the source of energy for our research.

8. Suggested citation

Dr. Abdi M Ali, Mr. Abdinasir Ali and Mr. Mohamed Said, 2021. Determinants of Undernutrition among Children under age 5 in Puntland, Department of Statistics, Puntland State, Somalia.

References

- [1] C. H. J Fanzo, "Global Nutrition Report: Shining a light to spur action on nutrition.," 2018.
- [2] C. Shinsugi, M. Matsumura, M. Karama , J. Tanaka, M. Changoma and S. Kaneko, "Factors associated with stunting among children according to the level of food insecurity in the household: a cross-sectional study in a rural community of Southeastern Kenya," *BMC public health*, vol. 15, no. 1, pp. 1-10, 2015.
- [3] WHO, "Child growth standards: length/height-for-age," 2006.
- [4] WHO, "Nutrition Landscape Information System (NLIS)," 2010.
- [5] S. Khan, S. Zaheer and N. F. Safdar, "Determinants of stunting, underweight and wasting among children < 5 years of age: evidence from 2012-2013 Pakistan demographic and health survey.," *BMC public health*, Vols. 1-15, p. 19, 2019.
- [6] UNICEF, "Situation Analysis of Children in Somalia," 2016.
- [7] M. De Onis, "WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age," 2006.
- [8] PLHDS, "Puntland Health and Demographic Survey (PLHDS)," UNFPA, 2020.
- [9] FSNAU, "Nutrition Update for Somalia - Preliminary findings from 2016 Gu season nutrition surveys among Internally Displaced Persons (IDPs) in Somalia," FAO, 2016.
- [10] R. E. Black, C. Levin, N. Walker, D. Chou, L. Liu, M. Temmerman and D. R. A. Group , *Reproductive, maternal, newborn, and child health: key messages from disease control priorities, Third Edition ed.*, vol. 2, 2016.
- [11] UNICEF, Somalia Nutrition Cluster Partners & FSNAU, 2020.
- [12] A. Ma'alin, D. Birhanu, S. Melaku and D. Tolossa, "Magnitude and factors associated with malnutrition in

children 6–59 months of age in Shinille Woreda, Ethiopian Somali regional state: a cross-sectional study. BMC," BMC Nutrition, 2016.

- [13] D. K. Kinyoki, J. A. Berkley, G. M. Moloney, N. B. Kandala and A. M. Noor, "Predictors of the risk of malnutrition among children under the age of 5 years in Somalia," *Public health nutrition*, 2015.
- [14] W. Girma and T. Genebo, "Determinants of nutritional status of women and children in Ethiopia.," 2002.
- [15] G. Aschalew, "Determinants of nutritional status of children in Amhara Region: A case study of Misrak Goffjam and Semen Wello Zones (Doctoral dissertation, M. Sc Thesis, DTRC/IDR, AAU).," 2002.
- [16] T. Genebo, W. Girma, J. Haider and T. S. Demisse, "The association of children's nutritional status to maternal education in Zigababoto, Guragie Zone," *Ethiopia J Health Dev*, 1999.
- [17] H. Teller and G. Yimar., "Levels and Determinants of Malnutrition in Adolescent and Adult Women in Southern Ethiopia," *Ethiopian Journal of Health Development*, 2000.
- [18] S. Ghosh, "Factors responsible for childhood malnutrition: A review of the literature," *Current Research in Nutrition and Food Science Journal*, pp. 360-370, 2020.
- [19] D. K. Kinyoki, N. B. Kandala, S. O. Manda, E. T. Krainski, G. A. Fugstad, G. M. Moloney and A. M. Noor, "Assessing comorbidity and correlates of wasting and stunting among children in Somalia using cross-sectional household surveys: 2007 to 2010," *Bmj Open*, 2016.
- [20] B. J. Akombi, K. E. Agho, J. J. Hall, N. Wali, A. Renzaho and D. Merom, "Stunting, wasting and underweight in sub-Saharan Africa: a systematic review.," *International journal of environmental research and public health*, 2017.
- [21] S. Khan, S. Zaheer and N. F. Safdar, "Determinants of stunting, underweight and wasting among children < 5 years of age: evidence from 2012-2013 Pakistan demographic and health survey," *BMC public health*, 2019.
- [22] MoHHS, "Somalia Nutrition Strategy," Ministry of Health and Human Services, Federal Republic of Somalia (FRS) and State Ministries of Health, 2020.
- [23] S. Cairncross, C. Hunt, S. Boisson, K. Bostoen, V. Curtis, I. C. Fung and W. P. Schmidt, "Water, sanitation and hygiene for the prevention of diarrhoea," *International journal of epidemiology*, 2010.
- [24] G. Fink, I. Günther and K. Hill, "The effect of water and sanitation on child health: evidence from the demographic and health surveys 1986–2007," *International journal of epidemiology*, 2011.
- [25] S. A. Esrey, J. B. Potash, L. Roberts and C. Shiff, "Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma," *Bulletin of the World Health organization*, 1991.
- [26] A. Sommerfelt, Elisabeth and M. K. Stewart, "Children's Nutritional Status. DHS Comparative Studies," *DHS Comparative Studies*, 1994.
- [27] T. Getaneh, A. Assefa and Z. Tadesse, "Protein-energy malnutrition in urban children: prevalence and determinants," *Ethiopian medical journal*, 1998.
- [28] T. Clasen, S. Boisson, P. Routray, B. Torondel, M. Bell, O. Cumming and W. P. Schmidt, "Effectiveness of a rural sanitation programme on diarrhoea, soil-transmitted helminth infection, and child malnutrition in

- Odisha, India: a cluster-randomised trial," *The Lancet Global Health*, 2014.
- [29] S. A. Esrey, J. P. Habicht and G. Casella, "The complementary effect of latrines and increased water usage on the growth of infants in rural Lesotho," *American journal of epidemiology*, 1992.
- [30] A. Onyango, K. Tucker and T. Eisemon, "Household headship and child nutrition: a case study in western Kenya," *Social Science & Medicine*, 1994.
- [31] U. Ramakrishnan, "Nutrition and low birth weight: from research to practice," *The American journal of clinical nutrition*, 2004.
- [32] V. Ishra and R. D. Retherford, "Does biofuel smoke contribute to anaemia and stunting in early childhood?," *International Journal of Epidemiology*, 2007.
- [33] P. L. Engle, S. Castle and P. Menon, "Child development: Vulnerability and resilience," *Social science & medicine*, 1996.
- [34] D. B. Aguillon, M. M. Caedo, J. C. Arnold and R. W. Engel, "The relationship of family characteristics to the nutritional status of pre-school children," *Food and Nutrition Bulletin*, 1982.
- [35] M. B. Rost, R. Forste and D. W. Haas, "Maternal education and child nutritional status in Bolivia: finding the links," *Social science & medicine*, 2005.
- [36] J. Kabubo-Mariara, G. K. Ndenge and D. K. Mwabu, "Determinants of children's nutritional status in Kenya: evidence from demographic and health surveys," *Journal of African Economies*, 2009.
- [37] B. A. Abuya, E. O. Onsomu, J. K. Kimani and D. Moore, "Influence of maternal education on child immunization and stunting in Kenya," *Maternal and child health journal*, 2011.
- [38] B. M. Popkin, "Time allocation of the mother and child nutrition.," *Ecology of food and nutrition*, 1980.
- [39] R. Abbi, P. Christian, S. Gujral and T. Gopaldas, "The impact of maternal work status on the nutrition and health status of children," *Food and Nutrition Bulletin*, 1991.
- [40] H. F. Ghazi, J. Mustafa, S. Aljunid, Z. M. Isa and M. A. Abdalqader, "Malnutrition among 3 to 5 years old children in Baghdad city, Iraq: a cross-sectional study," *Journal of health, population, and nutrition*, 2013.
- [41] H. Eshete, Y. Abebe, E. Loha, T. Gebru and T. Tesheme, "Nutritional status and effect of maternal employment among children aged 6–59 months in Wolayta Sodo Town, Southern Ethiopia: a cross-sectional study," *Ethiopian journal of health sciences*, 2017.
- [42] A. A. HOWLADER, M. KABIR and M. U. BHUIYAN, "Factors affecting health-seeking behavior of mothers: evidence from the 1993-94 Bangladesh Demographic and Health Survey," *Genus*, 2000.
- [43] P. K. Masibo, "Trends and Determinants of Malnutrition among Children Age 0-59 Months in Kenya (KDHS 1993, 1998, 2003, and 2008-09)," *DHS Working Papers No. 89*. Calverton, Maryland, USA: ICF International., 2013.
- [44] U. M. Gala, M. L. Godhia and Y. S. Nandanwar, "Effect of maternal nutritional status on birth outcome," *International Journal of Advanced Nutritional and Health Science*, 2016.
- [45] G. G. Woldeamanuel, T. G. Geta, T. P. Mohammed, M. B. Shuba and T. A. Bafa, "Effect of nutritional status of pregnant women on birth weight of newborns at Butajira Referral Hospital, Butajira, Ethiopia.," *SAGE open medicine*, 2019.

- [46] A. Jesmin, S. S. Yamamoto, A. A. Malik and M. A. Haque, " Prevalence and determinants of chronic malnutrition among preschool children: a cross-sectional study in Dhaka City, Bangladesh," *Journal of health, population, and nutrition*, 2011.
- [47] C. Marston and J. Cleland, "Do unintended pregnancies carried to term lead to adverse outcomes for mother and child? An assessment in five developing countries," *Population studies*, 2003.
- [48] M. S. Rahman, T. Howlader, M. S. Masud and M. L. Rahman, "Association of low-birth weight with malnutrition in children under five years in Bangladesh: do mother's education, socio-economic status, and birth interval matter?," *PloS one*, 2016.