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Stunting Among Children in Yemen:
Prevalence and Associated Factors

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STUNTING AMONG CHILDREN IN YEMEN:
PREVALENCE AND ASSOCIATED FACTORS

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1 INTRODUCTION

Malnutrition is part of a vicious cycle involving associated underlying factors; meaning that undernourishment is related not only to biological but also social aspects (WHO, 1995). Some factors—known as proximal factors—are directly associated with malnutrition, such as inadequate dietary intake and incidences of disease, while others are more distant but no less important. These are socio-economic in nature and are associated with children's nutritional conditions in a number of ways. For instance, poverty can be related to low levels of parental education, poor availability and quality of food, and lack of access to water/sanitation and adequate health care, all of which raise the risks of disease and contribute to poorer nutrient intake levels.

As the causes of child malnutrition and its associated factors are complex, ranging from biological and social to environmental factors, there are several models to explain its determinants. For the purpose of this paper, we have adapted the conceptual framework constructed by Hien and Hoa (2009). This framework was developed based on Victora et al. (1997), who proposed the use of frameworks and models for analysing the risk factors associated with health outcomes. It provides a way of understanding how the different factors that have an effect on child malnutrition may be connected. This conceptual framework allows us to verify how distal factors may operate through intermediate and proximal factors to affect the nutritional status of children (Darteh et al., 2014). In our adapted model, the characteristics associated with child malnutrition are disaggregated into three groups:

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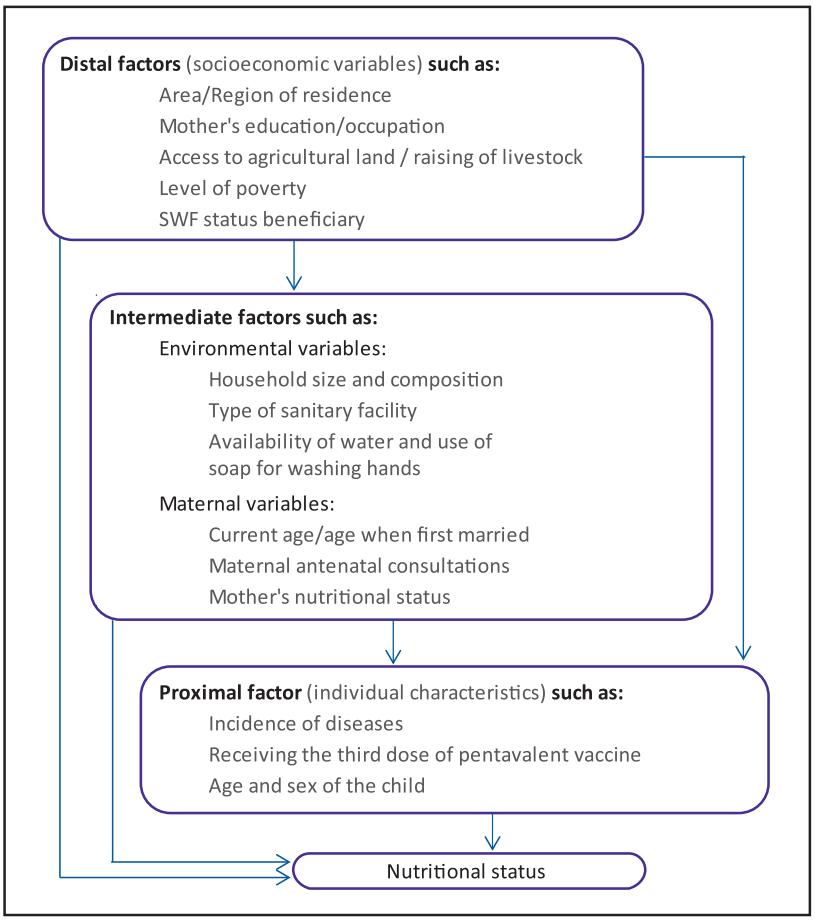
1) Distal factors, indicated by socio-economic variables such as region of residence, mother's education, access to land etc.;
2) Intermediate factors, including environmental factors and those related to maternal health; and
3) Proximal factors, such as incidence of diseases, age and sex of the child, feeding practices etc.

It is worth mentioning that researchers are often affected by the availability of information when empirically examining a phenomenon. With that in mind, our adapted conceptual framework to analyse the associated factors of child nutrition is shown in Figure 1. According to this model, socio-economic factors may both directly or indirectly influence all the remaining groups of risk factors (with the exception of sex and age). Furthermore, such groups may also include environmental factors (such as household size and infrastructure) and factors related to maternal health (Hien and Hoa, 2009). Although our conceptual framework presents a hierarchical structure, we highlight the fact that, for the purpose of our empirical analysis, we take into account the different factors associated with child malnutrition presented in this framework, without considering the potential hierarchy between the factors implicit in it.

FIGURE 1

Conceptual Hierarchical Framework of the coRrelates of Nutritional Status



Source: Adapted from Hein and Hoa (2009).

The main objective of this paper is to assess child malnutrition, with a focus on stunting, by considering the disparities across characteristics such as socio-economic and environmental factors, maternal characteristics, incidence of diseases etc. (as described in Figure 1). The results are based on the fourth round of the National Social Protection Monitoring Survey (NSPMS) in Yemen. A better understanding of the situation of Yemeni children is needed to provide policy recommendations and interventions that advance health equity, enhance nutritional well-being and promote children's rights.

2 METHODS

2.1 THE SURVEY

The NSPMS is a longitudinal household survey comprising four rounds of data collection during a period of 12 months—from October 2012 to September 2013.[1] This paper is based on the fourth round, with interviews undertaken in July, August and September 2013, as the survey follows a multiple panel rotation scheme. The analysis is based on a balanced sample with 6397 Yemeni households, with the exception of the Saa'da and Al-Jawf governorates, which were not included due to security reasons. The NSPMS dataset is freely available and can be downloaded from the webpage dedicated to the project (http://nspms-yemen.ipc-undp.org/). This website makes available new data and NSPMS associated publications covering several socioeconomic dimensions. It aims at encouraging research, disseminating knowledge and informing on improvements of social protection programmes in Yemen.

The survey collected data on anthropometric measurements (weight and height/length) and clinical signs (bilateral oedema) of all children under 60 months of age, so as to estimate indicators of stunting (child too short for their age), wasting (child too thin for their height/length) and underweight (child too thin for their age).

In order to classify children as undernourished, we used the reference population from the 2006 World Health Organization (WHO) Child Growth Standards. For instance, a child whose height-for-age z-score (HAZ)[2] is below -2 standard deviations from the mean is considered stunted, and a child whose height-for-age is below -3 standard deviations from the mean is considered severely stunted. Height-for-weight (WHZ) and weight-for-age (WAZ) indicators will also follow an analogous line of reasoning.

Children under six months old exhibited the highest percentage of implausible measurements in the whole sample; therefore, our analysis encompasses children aged 6–59 months. Among them, there were 527 children with implausible longitudinal growth figures for either height, weight or both, and an additional 42 children with implausible z-score values (exceeding three standard deviations from the mean). Missing and implausible values were excluded from the analysis. From the total of 5783 children aged 6–59 months, 16 per cent were excluded relative to each malnutrition indicator: 918 from the estimation of the stunting indicator, 917 for the wasting indicator and 910 for the underweight indicator.

It is important to highlight that screening of implausible child anthropometrics is common in the child malnutrition research field. The International Food Policy Research Institute (IFPRI) report on assessing food security in Yemen (Ecker et. al, 2010) is an example of a considerable percentage of children being excluded from the analysis due to implausible and/or missing values. Their cleaned dataset excluded approximately 40 per cent of the

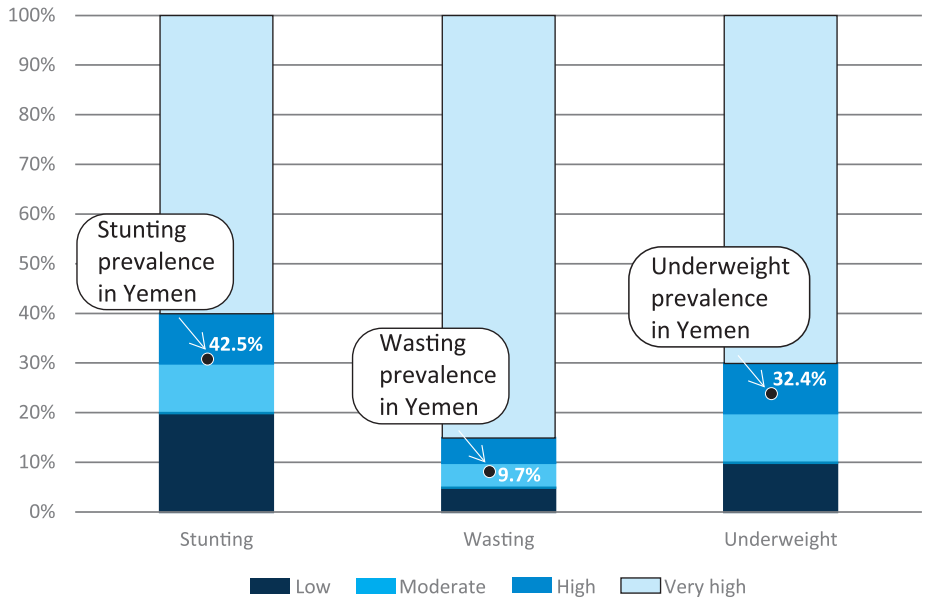
children, especially due to the weak quality of their height measurements. Also, the 2013 National Health and Demographic Survey (YNHDS) preliminary report indicated a high percentage of missing and implausible values (although lower than that of the IFPRI report): for 9 per cent of the 16,100 children analysed, weight and/or height were not measured, while for another 4 per cent the measurements were clearly incorrect and/or the child's age information was incomplete. Furthermore, some studies do not even mention either the amount of missing and implausible values or the way they were addressed. Such is case of the 2003 Family Health Survey, in which more than 10,000 Yemeni children were analysed and yet there is no reference to the number of missing and implausible values or how they had been treated.

Children's nutritional status in Yemen

Children's nutritional status has been widely used to assess the adequacy of their diet and growth during infancy, as it reflects overall child health and, thus, the overall health of an entire population. The situation of Yemeni children is serious; according to the 2012–2013 Yemen National Social Protection Monitoring Survey (NSPMS) final report, nearly half of the children below five years old were stunted (42.5 per cent), and 12.6 per cent were severely stunted. Wasting affected 9.7 per cent, with 1 per cent of children aged 6–59 months being severe cases. Furthermore, 32.4 per cent of children were too thin for their age. Figure 2 illustrates the severity of child malnutrition in Yemen by comparing these statistics to the four levels of the WHO classification for assessing the severity of undernutrition: low, moderate, high and very high malnutrition. As shown in Figure 2, Yemeni children are suffering from severe undernourishment. Whereas the prevalence of wasting was found to be near the upper bound of the moderate range in 2013, the prevalence of stunting and underweight had reached a high level in the same year.

FIGURE 2

Malnutrition Prevalence in Yemen (in 2013) According to the WHO Classification for Assessing Severity of under-five Child Malnutrition by Expected Prevalence Ranges



Source: Classification for assessing severity of malnutrition from WHO (1995); Yemen malnutrition prevalence from the NSPMS (2012–2013), round 4.

Child malnutrition in Yemen has decreased over the past decade. Between 1997 and 2003 the percentage of stunted children remained over 50 per cent (52 per cent in 1997—Yemen Demographic and Maternal and Child Health Survey—and 53 per cent in 2003—Yemen Family Health Survey), but in 2013 it had fallen to 46.5 per cent, based on the National Health and Demographic Survey (YNHDS) 2013 preliminary report. Nevertheless, Yemeni children are still in a critical situation, especially if we compare the country's statistics with those of a well-nourished population. In a healthy population, only 2.3 per cent of children would be classified as having low height and/or weight, even if they were 'healthy' individuals with no growth impairment (WHO, 1995).

It is worth highlighting the prevalence of stunting among Yemeni children found in previous studies. The YNHDS 2013 preliminary report showed that 46.5 per cent of Yemeni children under five years old were stunted. Also, the World Food Programme *Report on The State of Food Security and Nutrition in Yemen* launched in 2012 (based on the 2011 Comprehensive Food Security Survey) showed virtually the same prevalence (46.6 per cent). The NSPMS data present a lower prevalence of child stunting (42.5 per cent for children aged 6–59 months old) because of three main reasons. First, information on child height and/or weight was missing for around 6 per cent of the children; most of these children had a mother with no education (53 per cent) or only basic education (31 per cent), so they may be over-represented among stunted children. Second, our cross-sectional and longitudinal data cleaning excluded 10 per cent more children aged 6–59 months old; most of them also had a mother with low education. Finally, as mentioned before, due to security reasons, the Saa'da and Al-Jawf governorates are not included in this analysis.

Therefore, our estimate may at least be considered as a lower bound of the prevalence of stunting among Yemeni children in 2013. This is particularly endorsed by the fact that our 95 per cent confidence interval actually includes the YNHDS and World Food Programme estimates for child stunting in Yemen (once it varies from 37.9 per cent to 47.1 per cent).

Even considering 42.5 per cent of child stunting as a lower bound, it represents quite a high prevalence. This is an alarming situation, since child stunting is largely irreversible if it is caused by long-term insufficient nutrient intake and frequent infections. The long-term consequences of stunting for adult health and human capital have been emphasised in certain studies (Victora et al., 2008). Hereafter, this paper will focus on understanding the prevalence and correlates of child stunting in Yemen. The next sections detail the methodology and outcomes, respectively, of the empirical exercise.

2.2 METHODOLOGY

First we describe our sample. Then we show the results for our model on stunting. As our dependent variable is a dummy variable for stunting in which 1 means the child is stunted and 0 means the child is not stunted, we estimate a logistic model.

According to the framework presented in Figure 1 and subject to the availability of the variables in the NSPMS dataset, our independent variables are:

Distal factors:

- Mother's schooling;
- Mother's occupation in the last 30 months;
- Sex of the household head;
- Level of poverty (according to the proxy means test (PMT) formula);[3]
- Area/region of residence;
- Access to agricultural land;
- Raising of livestock;
- Social Welfare Fund (SWF) beneficiary status.

Intermediate factors:

- Food security consumption;[4]
- Number of days in which household members ate a source of protein (meat, poultry, fish or eggs);
- Use of bed nets when sleeping;
- Availability of water and use of soap for washing hands;
- Source of water in the household;
- Use of improved toilet facilities;
- Source of fuel for cooking;
- Asset ownership: fridge, TV/radio (as proxy for access to information);
- Distance from the nearest health facility;
- Household size (in terms of number of members) and composition (in terms of children aged less than 60 months);
- Maternal age at time of survey;
- Maternal age at first marriage;
- Number of antenatal consultations (as proxy for health access);
- Mother's nutritional status.

Proximal factors:

- Child received the third dose of pentavalent (as proxy for health access);
- Child did not have diarrhoea in the last 14 days;
- Child did not have any other health problems in the last 14 days;
- Age and sex of the child.

It is worth mentioning that in the empirical exercise we are considering all children aged 6–59 months for whom we have information on each and every variable included in the model explaining stunting among Yemeni children. We highlight the fact that the independent variable related to the mother's nutritional status, measured by mid-upper arm circumference (MUAC), was the only one with a high percentage of missing values (13 per cent), other than the dependent variable on stunting after cleaning (16 per cent). Although almost half of these children overlapped in terms of missing information concerning the independent and dependent variables, in order not to have our sample reduced, we decided to include children with no information on the mother's nutritional status in a separate category; therefore, the mother's nutritional status variable has three categories: mother is severely undernourished (MUAC below 21.3 cm); mother is not severely undernourished (MUAC equal to or greater than 21.3 cm); and no information on mother's MUAC.

2.3 RESULTS

2.3.1 Descriptive analysis

General descriptive analysis for the whole sample of children

The background characteristics of children whose anthropometric measurements were plausible and for whom we have information on the independent variables mentioned above are presented in Table 1. The goal of this table is twofold: to show a broad description of the characteristics—in terms of averages or percentages of children presenting each characteristic—of our sampled children (shown in columns 1 through 3) and to clarify how each independent variable included in the model was categorised (shown in the 'Variables description' column).

In general, the proportion of stunting among the sampled children was extremely high: 43 per cent were stunted, and 13 per cent were severely stunted. While 24 per cent were aged 12–23 months, 19 per cent were aged 48–59 months. Virtually 50 per cent (51.2) were males. Considering the mother's education as an important factor associated with child stunting, the situation in Yemen is alarming: only 9 per cent of the children have a mother who has reached secondary education. In general, female-headed households present worse conditions. In Yemen, less than 4 per cent of the children live in female-headed households. Fifteen per cent of the children are poor, and nearly 40 per cent are non-poor, according to the PMT. Yemen is a highly rural country; only 19 per cent of the children live in urban areas, whereas 42 per cent live in the mountainous area, 34 per cent in the plateau/desert area, 20 per cent in the Red Sea coastal area, and only 5 per cent in the Arabian Sea coastal area. More than half of the children (53.4 per cent) live in a household where none of its members own any piece of land. Nearly two thirds (64 per cent) of the children live in a household that raises some livestock. According to the SWF beneficiary status, 74 per cent of the children live in a household where there is no SWF beneficiary, 16 per cent live with a long-term-beneficiary, and 10 per cent live with a new beneficiary.

TABLE 1

Descriptive Statistics, Children Aged 6–59 Months — Yemen, 2013

Variables description	All children			Stunted children			Non-stunted children		
	Value	Confidence Interval		Value	Confidence Interval		Value	Confidence Interval	
		Lower bound	Upper bound		Lower bound	Upper bound		Lower bound	Upper bound
Prevalence of stunting (dependent variable)									
Percentage of stunted children	42.60	37.92	47.27	100.00	-	-	-	-	-
Percentage of severely stunted children	12.61	9.69	15.53	29.61	22.93	36.28	-	-	-
Distal factors (socio-economic characteristics)									
Mother has secondary education	8.70	6.35	11.04	5.00	2.46	7.54	11.44	8.03	14.85
Mother had no occupation in the last 30 days	44.11	38.95	49.27	38.46	31.47	45.46	48.31	42.28	54.33
Female household head	3.60	2.51	4.69	3.91	2.42	5.40	3.37	2.06	4.67
Level of poverty (Reference: Extremely poor)									
Extremely poor	14.77	11.02	18.51	15.40	8.86	21.94	14.30	10.32	18.27
Moderately poor	27.55	23.15	31.95	27.89	20.95	34.84	27.30	22.99	31.61
Vulnerable	18.68	15.14	22.21	18.62	13.90	23.34	18.72	14.34	23.09
Non-poor	39.00	33.99	44.02	38.08	30.60	45.57	39.69	34.04	45.33
Urban area of residence	18.85	14.13	23.58	12.51	8.00	17.02	23.56	17.22	29.90
Topography (Reference: Mountainous)									
Mountainous	41.81	35.31	48.31	54.50	44.89	64.11	32.40	26.01	38.79
Arabian Sea coastal area	5.02	3.32	6.73	0.94	0.45	1.42	8.05	5.21	10.90
Red Sea coastal area	19.57	13.36	25.79	19.22	10.91	27.53	19.84	13.00	26.67
Plateau/desert	33.59	28.08	39.10	25.34	18.56	32.12	39.71	33.16	46.26
Access to agricultural land (Reference: None)									
None	53.43	48.59	58.27	52.94	46.12	59.75	53.79	48.30	59.29
Owner + Free use	31.21	26.59	35.83	26.44	20.16	32.73	34.75	29.69	39.80
Tenant	15.36	12.23	18.49	20.62	15.62	25.61	11.46	8.49	14.42
Household raises some livestock	63.88	58.71	69.05	64.22	57.12	71.32	63.63	57.57	69.69
SWF beneficiary status (Reference: Non-beneficiary)									
Non-beneficiary	74.11	70.84	77.38	76.39	71.80	80.98	72.42	68.34	76.49
Long-term beneficiary	15.99	13.74	18.24	14.58	11.47	17.69	17.04	14.32	19.77
New beneficiary	9.90	7.77	12.04	9.04	6.60	11.48	10.54	7.46	13.62
Intermediate factors (environmental and maternal characteristics)									
Environmental characteristics Food Consumption Score (continuous)	57.00	54.87	59.13	54.15	51.80	56.49	59.11	56.41	61.82
Number of days per week household members ate protein (continuous)	2.92	2.63	3.20	2.35	1.95	2.75	3.34	3.04	3.64
Household members use bed net when sleeping	21.77	17.08	26.46	20.92	13.26	28.57	22.40	17.82	26.98 →

Household has enough water for washing hands, and members at least sometimes use soap before eating, before feeding a child, after using the latrine and after cleaning a child's faeces (Reference: Household has not enough water for washing hands or never uses soap before eating or before feeding child or after using the latrine or after cleaning a child's faeces)	60.50	55.61	65.38	53.18	44.72	61.64	65.92	61.07	70.78
Main source of water in the household is piped water (both inside the dwelling and inside the compound)	34.34	28.58	40.10	30.93	23.88	37.99	36.87	30.09	43.65
Household members do not use improved toilet facilities: Pit latrine with slab as hole cover; Pit latrine without slab/open hole; Bucket; Hanging toilet or latrine discharging to the open; No facilities/bush/field/in the open; Flush toilet to outside the house or to unknown place (Reference: Improved toilet facilities)	55.60	50.15	61.05	64.03	57.32	70.74	49.35	43.04	55.65
Main source of fuel for cooking is gas or electricity — electricity is a residual category	55.11	49.18	61.05	48.76	39.39	58.13	59.82	53.61	66.03
Household owns at least one fridge	31.53	26.88	36.18	19.51	14.56	24.45	40.45	34.72	46.19
Household owns at least one radio and/or TV (Reference: Does not own either)	70.54	65.84	75.23	62.09	55.03	69.16	76.80	71.66	81.94
Household is located more than one hour away from the nearest health facility	25.44	19.84	31.05	24.37	17.54	31.21	26.24	19.61	32.87
Household size in terms of number of members (Reference: 1–4)									
1–4	8.15	4.88	11.42	9.23	2.29	16.17	7.35	5.10	9.61
5–8	45.34	40.68	50.00	46.00	37.92	54.08	44.86	40.14	49.58
9+	46.51	42.73	50.29	44.78	38.86	50.69	47.79	43.02	52.56
Percentage of the household members aged less than 60 months (continuous)	26.69	25.52	27.86	28.24	26.38	30.09	25.54	24.39	26.69
Maternal characteristics									
Maternal age at time of survey (Reference: 15–24)									
15–24	21.68	17.96	25.40	23.70	17.11	30.30	20.18	16.55	23.81
25–34	48.81	44.19	53.42	48.71	41.86	55.55	48.88	43.48	54.27
35–44	22.32	18.58	26.07	21.60	15.92	27.29	22.85	18.15	27.55
45+	7.19	4.34	10.05	5.99	2.45	9.52	8.09	4.39	11.78 →

Maternal age at first marriage (Reference: 10–14)									
10–14	7.95	6.10	9.79	8.51	5.43	11.59	7.53	5.49	9.57
15–19	60.37	55.07	65.67	62.77	54.83	70.72	58.59	52.75	64.42
20–24	21.17	17.37	24.97	19.40	13.87	24.94	22.48	18.21	26.74
25+	10.51	6.27	14.76	9.31	2.92	15.70	11.41	7.20	15.61
Mother had at least 4 antenatal consultations during her last pregnancy occurring in the last 5 years	23.08	17.98	28.18	16.91	10.25	23.56	27.67	22.21	33.12
Mother's nutritional status (Reference: MUAC<21.3)									
Mother is not severely undernourished (MUAC>=21.3)	82.63	78.76	86.50	79.05	72.95	85.15	85.29	80.88	89.69
Mother is severely undernourished (MUAC<21.3)	11.86	8.77	14.95	16.51	10.67	22.35	8.41	5.75	11.07
Mother with missing data on MUAC	5.51	3.28	7.74	4.44	2.74	6.14	6.31	2.78	9.83
Proximal factors (individual characteristics)									
Child age in months (Reference: 6–11)									
6–11	9.31	7.53	11.10	5.62	3.40	7.85	12.05	9.57	14.54
12–23	23.69	20.49	26.90	24.50	18.45	30.54	23.10	19.63	26.56
24–35	24.16	21.58	26.74	28.86	23.55	34.16	20.68	17.68	23.68
36–47	23.70	21.10	26.30	25.24	21.03	29.45	22.56	18.83	26.29
48–59	19.13	16.58	21.69	15.78	12.64	18.93	21.62	17.92	25.31
Child is a boy	51.52	47.37	55.67	51.61	45.20	58.02	51.46	46.78	56.13
Child has received third dose of pentavalent vaccine according to the vaccination card and mother's information	66.55	61.84	71.27	64.27	57.75	70.79	68.25	63.23	73.26
Child did not have diarrhoea in the last 14 days	51.09	46.85	55.32	40.93	34.25	47.61	58.62	54.49	62.76
Child did not have any other health problems in the last 14 days	63.50	59.01	67.99	55.04	46.88	63.20	69.77	65.78	73.77
Number of observations		4,762			1,929			2,833	

Notes: Legend: * p<.1; ** p<.05; *** p<.01.

Source: NSPMS (2012–2013), round 4.

The Food Consumption Score (FCS) varies from 13 to 107 in our sample. This refers to food consumption in the household, therefore not specifically to children's food consumption. On average, children live in households for which the FCS is 57. As this score reflects the consumption of nine different groups of food, we also add a variable for the number of days the household members ate a source of protein (because its consumption is very important in avoiding child stunting). Children live in households that, on average, consume protein less than three days per week (2.92).

Sixty-one per cent of the children of the sample were from households where there is enough water for washing hands and which at least sometimes use soap before eating, before feeding a child, after using the latrine and after cleaning a child's faeces. Piped water is the main source of water in the household for only 34 per cent of the children. Only 32 per cent of the children live in a household that owns a fridge. A quarter (26 per cent) of children live in a household situated more than one hour away from the nearest health facility. More than 90 per cent of the children live in a household with at least five members. On average, the children of the sample live in households where over a quarter (26.7 per cent) of the members are children.

Most of the children's mothers are 25–34 years old (48.8 per cent); 22 per cent of them are very young (15–24 years old), and only 7 per cent are older (45 years old and up). For 68 per cent of children, their mothers married early, since the maternal age at first marriage was less than 20 years old. Only 23 per cent of the children have a mother with at least four antenatal consultations during her last pregnancy (occurring in the previous five years). This indicator may reflect a lack of access to health care, as antenatal care may work as a proxy for it. It may be informative to consider the mother's nutritional status when analysing child malnourishment. Almost 12 per cent of children had severely stunted mothers based on their MUAC measure (lower than 21.3 cm), and there was no information on maternal MUAC for an additional 5.5 per cent of children.

Immunisation and antenatal consultations may also work as a proxy for access to health care. Only 67 per cent of Yemeni children have received the third dose of pentavalent vaccine according to their vaccination card and mother's report. Being sick is a good predictor for child malnutrition, and diarrhoea is among the most important diseases for explaining it. In Yemen, nearly half of the children (48.9 per cent) had experienced diarrhoea in the 14 days before the survey, and 36.5 per cent of children had experienced some other health problem in the same period.

Table 1 also reveals the average differences between the stunted and not-stunted children (columns 4 through 9). The most significant differences between them are highlighted in the graphs that follow.

Comparing stunted and non-stunted children

Figure 3 shows the percentage of children aged 6–59 months who are stunted, according to their mother's education and their household's access to agricultural land (Figure 3a) and areas/regions of residence (Figure 3b).

While 36 per cent of the children who live in a household that owns (or has free use of) agricultural land were stunted, the figure is much higher (57 per cent) among those who rent land. Differences in maternal education are also striking. Whereas 44 per cent of the children whose mother does not have a secondary education are stunted, this figure shrinks to 24.5 per cent for the ones whose mother has had access to better education. The areas of the country with the highest prevalence of stunting are the mountainous ones. More than half (55.5 per cent) of the children living in such areas are stunted, compared to only 8 per cent of those living in the Arabian Sea coastal area. Around 28 per cent of the children who live in urban areas are stunted, compared to 46 per cent in rural areas.

FIGURE 3

Percentage of Children Aged 6–59 Months who are Stunted, According to Selected Distal Factors — Yemen, 2013

FIGURE 3a: Mother's Education and Access to Agricultural Land

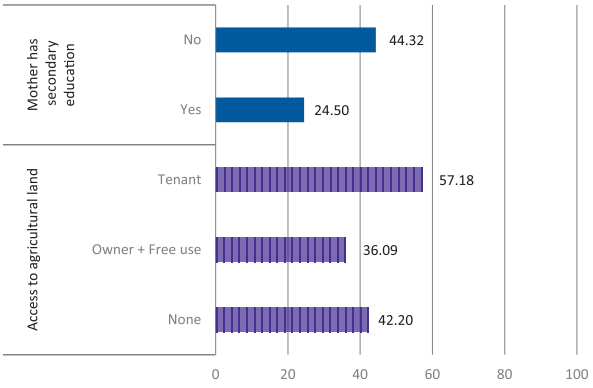
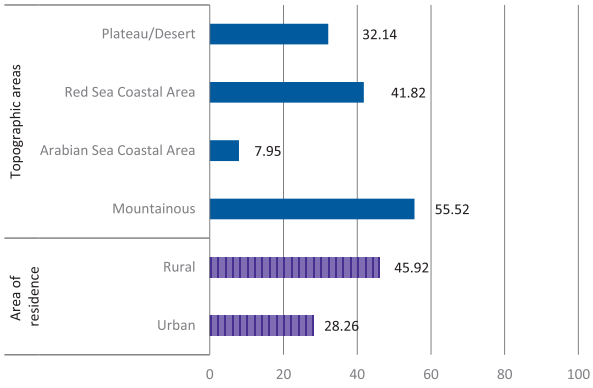


FIGURE 3b: Areas/Regions of Residence



Source: NSPMS (2012–2013), round 4.

Figure 4 shows a comparison between stunted and non-stunted children based on household members' protein intake (Figure 4a), hand washing practices, use of improved toilet facilities and radio/TV and fridge ownership (Figure 4b). The higher the number of days that household members consumed protein during the week before the survey, the lower the percentage of stunted children. For instance, 65 per cent of children living in households whose members had not eaten protein on any day of the previous week were stunted, whereas this percentage falls to less than 30 per cent among households whose members ate protein every day of the previous week.

Approximately 37.5 per cent of children living in a household with a radio and/or TV are stunted; this percentage increases to 55 per cent for households without access to those appliances. With regards to fridge ownership, while 26.4 per cent of children residing in a household with at least one fridge were stunted, this figure rises to around 50 per cent of those living in a household with no fridge. We also discover significant differences when analysing households' access to water for hand washing, combined with some regularity in the use of soap, in relation to children's nutritional status: while 37 per cent of children living in households with access to water and better hand-washing practices are stunted, this figure rises to more than 50 per cent of children living in households with no water and/or no use of soap when washing hands.

Finally, stunted children are over-represented among those who live in households with no improved toilet facilities. Whereas almost half of the children who live in households with improved toilet facilities are stunted, this figure decreases to 35.5 per cent for those living in households with improved sanitation.

FIGURE 4

Children Aged 6–59 Months who are Stunted According to Select Intermediate Factors — Yemen, 2013

FIGURE 4a: Number of Days/Week Household Members Ate Protein

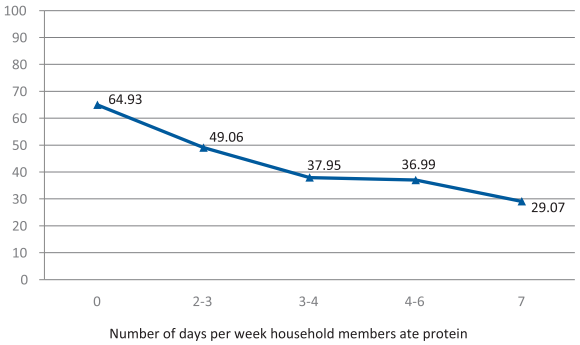
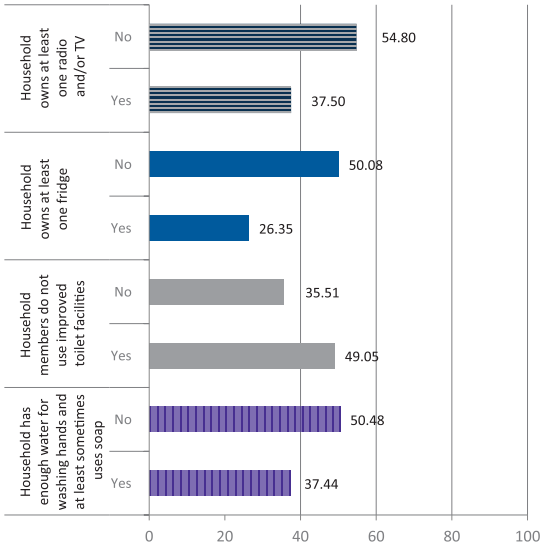


FIGURE 4b: Indicators for the Use of Improved Toilet Facilities and the Use of Water/Soap While Washing Hands as well as Indicators for Fridge and Radio/TV Ownership



Source: NSPMS (2012–2013), round 4.

Figure 5 presents the percentage of children who are stunted by the number of antenatal consultations in the mother's last pregnancy occurring in the last five years (Figure 5a) and her nutritional status (Figure 5b). The indicator for mothers who have had at least four antenatal consultations during their last pregnancy (the minimum number recommended by the WHO) works as a proxy for adequate health care access/utilisation. The percentage of children who are stunted among those whose mothers had adequate access to antenatal care in their last pregnancy is considerably lower (31 per cent) than among children of mothers without access to such care (46 per cent). Concerning the mother's nutritional status—as measured by their MUAC—we found that 59 per cent of children whose mothers are severely undernourished are stunted, while this figure is just 41 per cent for those whose mothers are not severely malnourished. It is important to highlight the percentage of missing information on mother's MUAC: 5.5 per cent for children aged 6–59 months. Among the children for whose mothers there is no MUAC information, around 34 per cent are stunted.

This figure is lower than the other categories of the mother's nutritional status, which is unexpected, given that missing information is usually more prevalent among cases in the worst situations. We may speculate that this phenomenon may be related to cultural barriers that prevented the measurements from being taken, which in turn leads us to be cautious when interpreting the outcomes related to this characteristic. However, as the mother's nutritional status is an important predictor of child malnutrition (Krasovec and Anderson, 1991; Egal and Oldewage-Theron, 2014), it is essential to reinforce the relevance of obtaining high-quality data on women's nutritional status. This is especially an issue when analysing child malnutrition, given that women of reproductive age are among the most vulnerable to malnutrition.

FIGURE 5

Percentage of Children Aged 6–59 Months who are Stunted, According to Mother's Health-related Characteristics (Intermediate Factors) — Yemen, 2013

FIGURE 5a: Mother Had at Least Four Antenatal Consultations in her last Pregnancy Occurring in the last Five Years

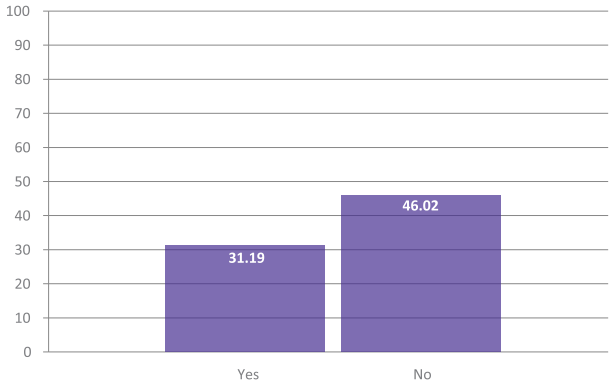
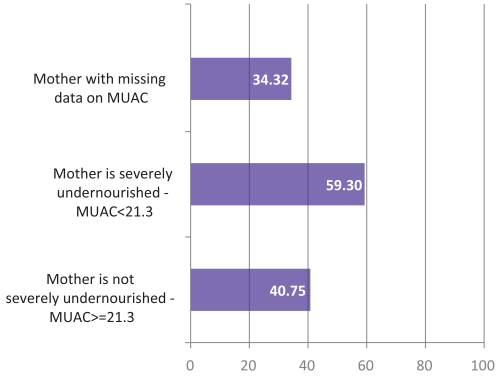


FIGURE 5b: Mother's Nutritional Status

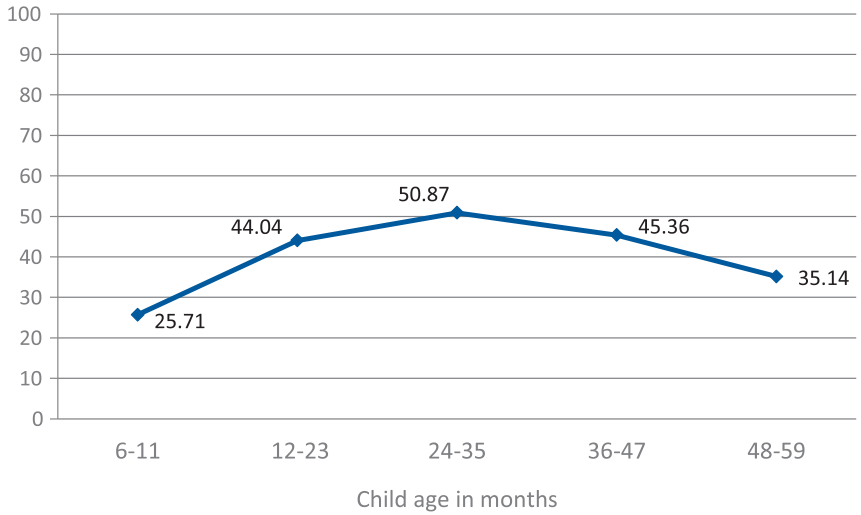


Source: NSPMS (2012–2013), round 4.

Figure 6 shows an analysis of the percentages of stunted children in different age groups. The highest percentage of stunted children is found in those aged 24–35 months (50.9 per cent). This is in accordance with the literature on stunting (Martorell and Young, 2012), as its peak usually occurs around 24 months of age.

FIGURE 6

Percentage of Children Aged 6–59 Months who are Stunted, by Age Groups — Yemen, 2013

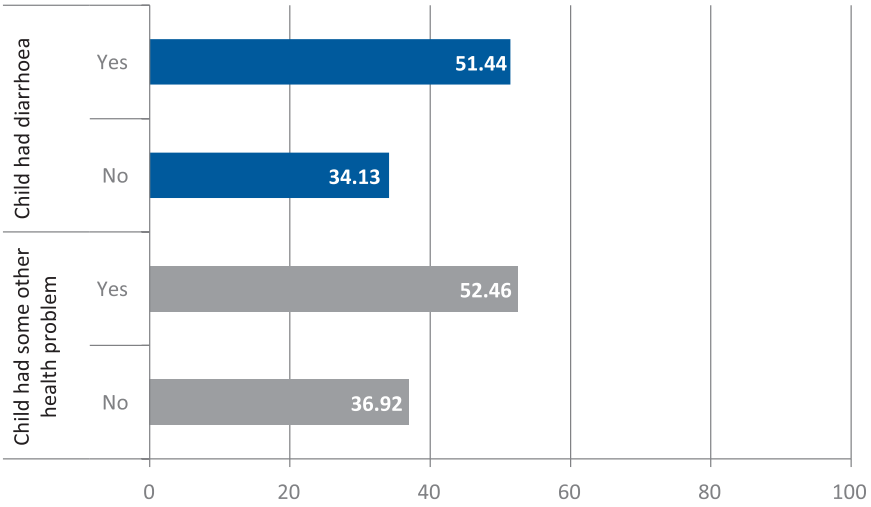


Source: NSPMS (2012–2013), round 4.

The percentage of children who are stunted according to the incidence of diarrhoea or other diseases in the 14 days preceding the survey is shown in Figure 7. Around one third (34 per cent) of the children who had not had diarrhoea were stunted, compared to over 50 per cent of those who had had at least one episode of diarrhoea in the 14 days prior to the survey. Regarding the occurrence of diseases other than diarrhoea, 37 per cent of children who had not had any other diseases were stunted, compared to 52.5 per cent of those who suffered some other ailment.

FIGURE 7

Percentage of Children Aged 6–59 Months who are Stunted, According to the Incidence of Diarrhoea or other Diseases in the Previous 14 Days — Yemen, 2013



Source: NSPMS (2012–2013), round 4.

2.3.2 Multivariate analysis

As previously mentioned, a logistic regression was used to further analyse the correlates of stunting among children under five years of age in Yemen, based on the hierarchical framework for analysing the factors associated with children's nutritional status developed by Hien and Hoa (2009). Multivariate analysis allows for a better understanding of the association between variables, since it minimises misinterpretations caused by the existence of confounding factors. Our findings indicate that some distal, intermediate and proximal factors are significantly associated with child stunting, even after controlling for quite a lot of confounding factors.

Before analysing the results we found, it is worth mentioning that although our conceptual framework has a hierarchical structure—which would suggest performing the multivariate analysis in steps: first adding distal, then intermediate and finally proximal factors—we only show our final logistic model (because of space constraints), which controls for all confounding factors present in Figure 1.

The logistic regression results of the factors associated with child stunting are presented in Table 2. An important note of interpretation relates to the fact that the distal factors may

affect child malnutrition through other channels. For instance, the level of poverty of a household will be captured by other variables included in the model, such as access to water and sanitation, and assets ownership. Therefore, it would be incorrect to think that the level of poverty has little to no impact on children's nutritional status after adjustment for confounding factors, since the overall effect of this variable will be underestimated due to the presence of mediating factors.

TABLE 2

Logistic Model on Global Stunting for Children Aged 6–59 Months — Yemen, 2013

Variables description		Odds ratio
Distal factors (socioeconomic characteristics)		
Mother has secondary education		0.53**
Mother had no occupation in the last 30 days		1.00
Female household head		1.23
Level of poverty (Reference: Extremely poor)		
	Moderately poor	0.73
	Vulnerable	0.70
	Non-poor	0.63*
Urban area of residence		0.74
Topography (Reference: Mountainous)		
	Arabian Sea coastal area	0.11***
	Red Sea coastal area	0.47**
	Plateau/desert	0.43***
Access to agricultural land (Reference: None)		
	Owner + Free use	0.60**
	Tenant	1.13
Household raises livestock		0.83
SWF beneficiary status (Reference: Non-beneficiary)		
	Long-term beneficiary	0.76*
	New beneficiary	0.84
Intermediate factors		
Environmental characteristics		
Food Consumption Score (continuous)		1.02***
Number of days per week household members ate protein (continuous)		0.87**
Household members use bed net when sleeping		0.76
Household members have enough water for washing hands and at least sometimes use soap before eating, before feeding a child, after using the latrine and after cleaning a child's faeces (Reference: Household has not enough water for washing hands or never uses soap before eating, before feeding a child or after using the latrine or after cleaning a child's faeces)		0.64***
Main source of water in the household is piped water (both inside the dwelling and inside the compound)		1.11
Household members do not use improved toilet facilities: Pit latrine with slab as hole cover; Pit latrine without slab/open hole; Bucket; Hanging toilet or latrine discharging to the open; No facilities/bush/field/in the open; Flush toilet to outside the house or to unknown place (Reference: Improved toilet facilities)		0.96

→

Main source of fuel for cooking is gas or electricity—electricity is a residual category		0.96
Household owns at least one fridge		0.49***
Household owns at least one radio and/or TV (Reference: Does not own either)		0.82
Household is located more than one hour away from the nearest health facility		0.49***
Household size in terms of number of members (Reference: 1–4)		
	5–8	1.25
	9+	1.40
Percentage of the household members aged less than 60 months (continuous)		1.59
Maternal characteristics		
Maternal age at the time of survey (Reference: 15–24)		
	25–34	0.87
	35–44	0.77
	45+	0.64
Maternal age at first marriage (Reference: 10–14)		
	15–19	1.06
	20–24	1.08
	25+	1.05
Mother had at least 4 antenatal consultations in her last pregnancy occurring in the last 5 years		0.73
Mother's nutritional status (Reference: Mother is severely undernourished (MUAC < 21.3))		
	Mother is not severely undernourished (MUAC >= 21.3)	0.61*
	Mother with missing data on MUAC	0.34***
Proximal factors (individual characteristics)		
Child age in months (Reference: 6–11)		
	12–23	2.91***
	24–35	4.33***
	36–47	3.57***
	48–59	2.57***
Child is a boy		1.04
Child has received third dose of pentavalent vaccine according to the vaccination card and mother's information		0.89
Child did not have diarrhoea in the last 14 days		0.64***
Child did not have any other health problems in the last 14 days		0.60***
Constant		2.62
Number of observations		4,762

Source: NSPMS (2012–2013), round 4.

Notes: * p<.1; ** p<.05; *** p<.01.

Distal factors

Mother's educational attainment plays a substantial role in stunting among Yemeni children under the age of five years. Children whose mothers have secondary education are less likely to be stunted than other children. We have tried some different categorisations such as

considering four educational attainment categories or even a continuous variable. The results showed that having a mother with secondary education makes all the difference, reducing the likelihood of being stunted by 47 per cent.

Level of poverty is a measure originating in the PMT formula. Simply put, it is a score that combines information on the household's and the head of the household's characteristics, asset ownership, social categories (partially disabled or severely ill, fully disabled or severely ill, elderly, orphans) and economic categories (unemployed, women without a breadwinner). The level of poverty variable has four categories: extremely poor, moderately poor, vulnerable and non-poor. In fact, we found that being non-poor is marginally negatively associated with the probability of being stunted (OR=0.63, $p<0.10$).

Access to agricultural land, although one of the dimensions used to estimate the PMT score (and subsequently used to generate the level of poverty variable), is also included in the model to ensure that information on access to land is taken into account, regardless of PMT score. According to our model, having free access to land is significantly associated with a reduction in the probability of being stunted (OR=0.60, $p<0.05$).

Topography was significantly related to stunting. It disaggregates the areas of residence into mountainous area, the Arabian Sea coastal area, the Red Sea coastal area and the plateau/desert area. The highest levels of child stunting are found in the mountainous area. For instance, living in the Arabian Sea coastal area is associated with a considerable reduction in the likelihood of being stunted (OR=0.11, $p<0.01$). Differences in child stunting among regions could be due not only to natural conditions (such as climate and soil) but also to differences in values, beliefs and cultures between the regions. Regarding areas of residence (whether rural or urban), there was no statistical association with child stunting. This outcome would seem counterintuitive, since there were significantly fewer urban children among those who are stunted than their non-stunted counterparts. Furthermore, other studies have found that food insecurity is far more widespread in rural areas than urban areas (Ecker et al., 2010). The lack of statistical significance concerning this variable indicates a strong correlation with other predictors. In fact, when individually analysing the correlation between each of the covariates and the dummy variable on urban residence, we found that the inequality between urban and rural areas is mainly explained by household access to agricultural land and raising livestock.

SWF beneficiary status proved to be marginally significant towards explaining stunting. Living in a household where there is at least one long-term beneficiary of the SWF is correlated with a reduction in the probability of being stunted (OR=0.76, $p<0.10$).

Intermediate factors

Protein intake is closely related to child stunting. The more often the children ate protein in the previous week, compared to not eating any (in terms of number of days), the lower their likelihood of being stunted (OR=0.87, $p<0.05$).

Availability of water combined with soap use while washing hands demonstrated a significant relationship with child stunting. Having enough water for washing hands and using soap at least sometimes before eating, before feeding a child, after using the latrine and after cleaning a child's faeces is associated with a decrease of 36 per cent in the probability of a child being stunted.

Ownership of a fridge is also a component of the PMT formula; it was included in the model to identify households which own one, regardless of their PMT score. Owning a fridge is correlated with a 51 per cent reduction in the probability of a household containing a stunted child.

Living in a household located far from a health facility (more than one hour away from the nearest one) is strongly associated with a lower chance of a child being stunted (OR=0.49, $p<0.01$). This was the only unexpected result of the model. We would have expected that living far from a health facility would mean poorer access to health care, therefore being correlated to a higher chance of a child being stunted. One reason for this unexpected outcome may be that households located at least one hour away from the nearest health facility in Yemen are actually the wealthiest. Nevertheless, further investigation is needed regarding this result.

Mother's nutritional status is also an important correlate of child stunting. Having a mother who is not severely undernourished is marginally associated with a lower chance of a child being stunted than among children whose mothers were severely malnourished (OR=0.61, $p<0.10$). Furthermore, children whose mothers had no MUAC information also showed a lower likelihood of being stunted than those with severely undernourished mothers (OR=0.34, $p<0.01$). This result reinforces the relevance of accurately measuring the mother's nutritional status (either through MUAC, waist circumference, body mass index or any other characteristic that may work as a proxy for the mother's nutritional status), which could be helpful in understanding the factors associated with child malnutrition.

Proximal factors

The age of the child was significantly associated with its likelihood of being stunted. Children aged 24–35 months showed the highest probability of being stunted; they were 4.3 times more likely to be stunted than those aged 6–11 months. This evidence supports the literature about the age when stunting reaches its peak (around 24 months).

Incidence of diarrhoea and incidence of other health problems in the previous 14 days are both strong predictors of child stunting. Not having diarrhoea is associated with a reduction of 36 per cent in the likelihood of being stunted, and not having any diseases other than diarrhoea is correlated to a reduction of 40 per cent.

2.3.3 Robustness check

As 16 per cent of all children aged 6–59 months were missing information on stunting, it became imperative to verify whether the exclusion of these children from our analysis introduced bias to our estimates. With this goal in mind, we ran several models on stunting, among which the only differences were the rules under which the missing values in stunting were imputed; thus we included as many children as possible in the models (keeping those who had information for all the remaining variables being studied).

Table 3 shows examples of these models and details how the missing data were imputed in each case. It should be noted that including all children aged 6–59 months—by imputing their stunting status whenever this information was missing—does not produce substantive changes in the results presented in the previous section. The direction of the odds ratios (in terms of showing a negative or positive association with the dependent variable) remains identical. Furthermore, although the magnitude and/or significance of the odds experienced

some variation, our main results remain similar. Additionally, when analysing the models listed in Table 3, it is possible to identify the boundaries between which the odds of each independent variable may be found. In this sense, the odds ratios found in our main model should not be interpreted as numbers per se, but as an approximate association between each specific child characteristic and their probability of being stunted given the model's specification.

TABLE 3

Robustness Check: Analysing How Children with Missing Values on Stunting Would Interfere in our Main Results if they were Included as Part of our Sample — Yemen, 2013

Variable	Main model (missing values excluded)	Models where the missing values were all imputed and the way they were imputed						
		All missing values imputed as stunted children	All missing values imputed as non-stunted children	All missing values randomly imputed as stunted or non-stunted				
				Model 1	Model 2	Model 3	Model 4	Model 5
Mother has secondary education	0.53**	0.82	0.49**	0.56**	0.63	0.58*	0.60*	0.59**
Mother had no occupation in the last 30 days	1.00	0.93	1.06	1.00	1.01	0.93	1.07	1.04
Female household head	1.23	1.37	1.04	1.43	1.26	1.13	1.17	1.34
Level of poverty								
(Reference: Extremely poor)								
Moderately poor	0.73	0.73	0.81	0.73	0.88	0.63**	0.83	0.66*
Vulnerable	0.70	0.66	0.80	0.66	0.81	0.59**	0.75	0.70
Non-poor	0.63*	0.64*	0.72	0.62**	0.83	0.50***	0.68	0.61**
Urban area of residence	0.74	0.81	0.76	0.81	0.84	0.72	0.82	0.79
Topography								
(Reference: Mountainous)								
Arabian Sea coastal area	0.11***	0.32***	0.11***	0.26***	0.19***	0.16***	0.20***	0.22***
Red Sea coastal area	0.47**	0.53**	0.51**	0.52**	0.53**	0.51**	0.47***	0.53**
Plateau/desert	0.43***	0.66**	0.40***	0.53***	0.50***	0.48***	0.51***	0.50***
Access to agricultural land								
(Reference: None)								
Owner + Free use	0.60**	0.68*	0.69*	0.62***	0.74	0.70**	0.63**	0.65**
Tenant	1.13	1.10	1.28	1.05	1.19	1.17	1.12	1.12
Household raises some livestock	0.83	0.88	0.77	0.81	0.75*	0.82	0.88	0.90
SWF beneficiary status								
(Reference: Non-beneficiary)								
Long-term beneficiary	0.76*	0.87	0.75*	0.88	0.84	0.89	0.81	0.82
New beneficiary	0.84	0.98	0.87	0.96	0.98	1.08	0.97	0.99
Food Consumption Score (continuous)	1.02***	1.01***	1.02***	1.01***	1.02***	1.02***	1.01***	1.01***
Number of days per week household members ate protein (continuous)	0.87**	0.91**	0.87***	0.89**	0.90**	0.89**	0.88***	0.90**
Household members use bed net when sleeping	0.76	0.78*	0.79	0.76*	0.87	0.80	0.91	0.73** →

Household has enough water for washing hands and at least sometimes uses soap before eating, before feeding a child, after using the latrine and after cleaning a child's faeces (Reference: Household has not enough water for washing hands or never uses soap before eating or before feeding child or after using the latrine or after cleaning a child's faeces)	0.64***	0.74**	0.70**	0.73**	0.76*	0.75*	0.75*	0.74**
Main source of water in the household is piped water (both inside the dwelling and inside the compound)	1.11	1.08	1.04	1.08	0.99	1.08	1.08	1.07
Household members do not use improved toilet facilities: Pit latrine with slab as hole cover; Pit latrine without slab/open hole; Bucket; Hanging toilet or latrine discharging to the open; No facilities/bush/field/in the open; Flush toilet leading outside of the house or to an unknown place (Reference: Improved toilet facilities)	0.96	1.02	0.94	1.00	1.00	0.99	1.03	0.96
Main source of fuel for cooking is gas or electricity — electricity is a residual category	0.96	0.90	1.02	0.97	0.95	0.94	0.97	0.85
Household owns at least one fridge	0.49***	0.62***	0.51***	0.60***	0.64**	0.58***	0.59***	0.53***
Household owns at least one radio and/or TV (Reference: Does not own either)	0.82	0.80	0.83	0.78	0.78	0.86	0.81	0.84
Household is located more than one hour away from the nearest health facility	0.49***	0.60***	0.45***	0.56***	0.54***	0.57***	0.60***	0.53***
Household size in terms of number of members (Reference: 1–4)								
5–8	1.25	1.18	1.19	1.10	1.23	1.27	1.15	1.24
9+	1.40	1.15	1.33	1.13	1.37	1.20	1.13	1.20
Percentage of the household members aged less than 60 months (continuous)	1.59	1.77	1.13	1.40	1.51	1.25	1.48	1.27
Maternal age at time of survey (Reference: 15–24)								
25–34	0.87	0.86	0.87	0.87	0.92	0.89	0.91	0.92
35–44	0.77	0.94	0.76	0.82	0.90	0.77	0.77	0.79
45+	0.64	0.57	0.75	0.63	0.75	0.60	0.76	0.61
Maternal age at first marriage (Reference: 10–14)								
15–19	1.06	1.07	1.01	1.08	1.11	1.09	1.10	1.04
20–24	1.08	1.24	1.00	1.09	1.36	1.14	1.22	1.10
25+	1.05	1.16	0.94	1.15	1.13	1.00	1.06	1.02 →

Mother had at least 4 antenatal consultations in her last pregnancy occurring in the last 5 years	0.73	0.71*	0.80	0.83	0.74	0.76	0.88	0.77
Mother's nutritional status (Reference: Mother is severely undernourished (MUAC <21.3))								
Mother is not severely undernourished (MUAC >=21.3)	0.61*	0.62*	0.65*	0.59**	0.62**	0.60*	0.60**	0.65*
Mother with missing data on MUAC	0.34***	1.07	0.21***	0.59	0.58*	0.34***	0.42**	0.43**
Child has received third dose of pentavalent vaccine according to the vaccination card and mother's information	0.89	0.92	0.80	0.91	0.75*	0.82	0.80	1.04
Child did not have diarrhoea in the last 14 days	0.64***	0.75*	0.67***	0.66***	0.74**	0.75**	0.72**	0.73**
Child did not have any other health problems in the last 14 days	0.60***	0.65***	0.60***	0.70**	0.60***	0.59***	0.59***	0.64***
Child age in months (Reference: 6–11)								
12–23	2.91***	2.01**	2.78***	2.61***	1.99**	2.70***	2.26***	2.27***
24–35	4.33***	2.79***	4.29***	3.54***	3.20***	3.97***	3.31***	3.01***
36–47	3.57***	2.33***	3.47***	2.85***	2.74***	3.34***	2.84***	2.59***
48–59	2.57***	1.69*	2.59***	2.18***	1.85**	2.42***	2.08***	1.89**
Child is a boy	1.04	1.09	1.00	1.08	1.08	1.00	1.02	1.09
Constant	2.62	2.66	2.52	2.77	1.92	2.80	2.40	2.64
Number of observations	4,762	5,548	5,548	5,548	5,548	5,548	5,548	5,548

Source: NSPMS (2012-2013), round 4.

Notes: * p<.1; ** p<.05; *** p<.01.

3 DISCUSSION AND CONCLUSION

Cultural aspects closely related to socio-economic factors can also help to explain the aetiology of children's poor growth. Examples include feeding taboos that can influence early initiation and duration of breastfeeding, and general childcare practices (WHO, 1995). According to UNICEF (2014), many women in Yemen believe that the first milk produced is unclean because of its different colour compared to the milk produced a few days after birth. As a result, some mothers feed their children with a combination of sugar and water, leading children to become increasingly malnourished. Also, a lack of confidence in the ability to breastfeed is causing Yemeni women to turn away from it. This insecurity is furthered by the marketing campaigns of companies that produce infant formula. Women believe that, ideally, feeding their children should be exactly like in the adverts, but they do not realise that their children's formula is usually mixed with impure water and placed in unsterilised bottles, which often causes the child to become ill.

Having said that, we found it essential to consider indicators for adequate breastfeeding and others for minimum dietary diversity while estimating a model; both sets of information are available in the Yemen NSPMS dataset, although only for children aged less than 24 months. This would allow us to verify whether the inclusion of these variables would change the magnitude and significance of the main predictors found in the model presented in section 2.3.2 (our main model). The only reason for not including these variables in that model

is that they are not available for children aged over 23 months. As the prevalence of stunting reaches its peak at 24 months of age, a model including only children aged 6–23 months would not adequately contribute to a better understanding of the correlates of child stunting.

As a final robustness check to verify how our results would change with the inclusion of indicators for adequate breastfeeding and minimum dietary diversity, we first estimated a model for children aged 6–23 months where we only included the variables specified in our main model. Then we included in the model:[5] 1) an indicator on the child having the minimum dietary diversity in the previous 24 hours; and 2) an indicator on the child being breastfed from the first hour of their birth. Both variables were significant (at 5 per cent) and indicated that they were associated with a strong reduction in the likelihood of a child being stunted. Nonetheless, the inclusion of both indicators on child nutrition in the model has not substantially changed the odds ratios or the statistical significance of the other relevant variables. Thus these models allow us to conclude that our main findings would remain similar after controlling for adequate child feeding: mother's nutrition and education, access to land, living in a household where there is at least one long-term SWF beneficiary (marginally significant), living in a non-poor household (marginally significant), eating protein more often, having good hygiene practices—such as washing hands with water and soap, owning a refrigerator and not having a disease—remain strongly associated with a lower likelihood of child stunting in Yemen. It is worth mentioning that when adding the 'minimum dietary diversity' and 'timely start of breastfeeding' variables to the model, the significance of the mother's nutritional status is reduced.

This evidence suggests that adequate feeding may compensate for the deleterious effects that the mother's undernourishment may have on her child's nutrition, as the significance of the odds ratio for the 'mother's nutritional status' variable tends to diminish after including the 'adequate feeding' and 'timely breastfeeding' variables.

To improve the nutritional status of Yemeni children, the factors which are significantly associated with stunting should be addressed. First, the correlation between regions of residence and prevalence of child stunting could be reduced by putting in place culturally suitable policies to promote adequate food intake—which need to apply not only to the children but also their mothers (especially while nursing). Such interventions, together with policies aiming at changing attitudes towards women's education, would also help to promote proper child feeding practices. In addition, pro-poor programmes should be implemented to reduce the positive association between household wealth and the likelihood of a child being stunted.

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ANNEX

TABLE A1

Logistic Models on Global Stunting — Yemen, 2013

Variables description	Odds ratio		
	Main model (as a matter of comparison)	Children aged 6–23 months (not including indicators for adequate breastfeeding and for minimum dietary diversity)	Children aged 6–23 months (including indicators for adequate breastfeeding and for minimum dietary diversity)
Distal factors (socioeconomic characteristics)			
Mother has secondary education	0.53**	0.53	0.47
Mother had no occupation in the last 30 days	1.00	1.08	1.16
Female household head	1.23	0.58	0.52
Level of poverty (Reference: Extremely poor)			
Moderately poor	0.73	0.97	0.94
Vulnerable	0.70	0.62	0.59
Non-poor	0.63*	0.68	0.68
Urban area of residence	0.74	0.71	0.79
Topography (Reference: Mountainous)			
Arabian Sea coastal area	0.11***	0.11***	0.12***
Red Sea coastal area	0.47**	0.34**	0.29***
Plateau/desert	0.43***	0.41***	0.35***
Access to agricultural land (Reference: None)			
Owner + Free use	0.60**	0.56*	0.51**
Tenant	1.13	0.91	0.81
Household raises some livestock	0.83	0.49**	0.53**
SWF beneficiary status (Reference: Non-beneficiary)			
Long-term beneficiary	0.76*	0.63*	0.65
New beneficiary	0.84	0.47**	0.48**
Intermediate factors			
Environmental characteristics			
Food Consumption Score (continuous)	1.02***	1.04***	1.04***
Number of days per week household members ate protein (continuous)	0.87**	0.81**	0.82**
Household members use bed net when sleeping	0.76	0.72	0.77
Household has enough water for washing hands and at least sometimes uses soap before eating, before feeding a child, after using the latrine and after cleaning a child's faeces (Reference: Household has not enough water for washing hands or never uses soap before eating or before feeding child or after using the latrine or after cleaning a child's faeces)	0.64***	0.55**	0.52**
Main source of water in the household is piped water (both inside the dwelling and inside the compound)	1.11	1.94**	1.97** →

Household members do not use improved toilet facilities: Pit latrine with slab as hole cover; Pit latrine without slab/open hole; Bucket; Hanging toilet or latrine discharging to the open; No facilities/bush/field/in the open; Flush toilet to outside the house or to unknown place (Reference: Improved toilet facilities)	0.96	1.22	1.23
Main source of fuel for cooking is gas or electricity — electricity is a residual category	0.96	0.75	0.76
Household owns at least one fridge	0.49***	0.35***	0.33***
Household owns at least one radio and/or TV (Reference: Does not own either)	0.82	1.11	1.09
Household is located more than one hour away from the nearest health facility	0.49***	0.67	0.66
Household size in terms of number of members (Reference: 1–4)			
5–8	1.25	0.87	0.86
9+	1.4	1.66	1.66
Percentage of the household members aged less than 60 months (continuous)	1.59	6.68	6.24
Maternal characteristics			
Maternal age at time of survey (Reference: 15–24)			
25–34	0.87	1.29	1.33
35–44	0.77	0.6	0.59
45+	0.64	1.45	1.65
Maternal age at first marriage (Reference: 10–14)			
15–19	1.06	0.95	0.95
20–24	1.08	1.59	1.62
25+	1.05	2.73*	2.86*
Mother had at least 4 antenatal consultations in her last pregnancy occurring in the last 5 years	0.73	0.63*	0.59*
Mother's nutritional status (Reference: Mother is severely undernourished (MUAC <21.3))			
Mother is not severely undernourished (MUAC >=21.3)	0.61*	0.76	0.78
Mother with missing data on MUAC	0.34***	0.28**	0.34*
Proximal factors (individual characteristics)			
Child age in months (Reference: 6–11)			
12–23	2.91***	3.36***	3.79***
24–35	4.33***		
36–47	3.57***		
48–59	2.57***		
Child is a boy	1.04	2.06***	1.95***
Child has received third dose of pentavalent vaccine according to the vaccination card and mother's information	0.89	0.74	0.74
Child did not have diarrhoea in the last 14 days	0.64***	0.40***	0.45*** →

Child did not have any other health problems in the last 14 days	0.60***	1.00	0.98
Child had minimum dietary diversity	-	-	0.53**
Child started breastfeeding within 1 hour from birth	-	-	0.48**
Constant	2.62	0.30	0.54
Number of observations	4,762	1,459	1,415

Source: NSPMS (2012–2013), round 4.

Notes: * p<.1; ** p<.05; *** p<.01.

NOTES

1. The NSPMS follows a two-phase stratified sampling design. Therefore, we take into account its complex sample design while estimating any statistics either concerning the descriptive or the multivariate analysis presented in this paper. For further information on the statistical procedures adopted for calculating the cross-sectional and longitudinal sampling weights and on the appropriate use of weights, please refer to: *Technical Note No. 2 – Technical Report on the Cross-sectional Sampling Weights for the Yemen National Social Protection and Monitoring Survey* <http://nspms-yemen.ipc-undp.org/wp-content/uploads/2015/01/2-Note-on-cross-sectional-weights.pdf>; *Technical Note No. 3 - Note on Longitudinal Weights* <http://nspms-yemen.ipc-undp.org/wp-content/uploads/2015/01/3-Note-on-longitudinal-weights.pdf>; and *Technical Note no.4 - How to Use the Sampling Weights* <http://nspms-yemen.ipc-undp.org/wp-content/uploads/2015/01/4-How-to-use-the-sampling-weights.pdf>.

2. A z-score is the number of standard deviations below or above the median value for the reference population (WHO, 2006).

3. For a detailed description of the construction of the level of poverty indicator, please refer to *Technical Note No.6 – Note on Some Derived Variables* <http://nspms-yemen.ipc-undp.org/wp-content/uploads/2015/01/6-Note-on-some-derived-variables.pdf>.

4. For a detailed description of the construction of the food security consumption score, please refer to *Technical Note No.10 – Note on the Food Consumption Score (FCS) Variable* <http://nspms-yemen.ipc-undp.org/wp-content/uploads/2015/01/10-Note-on-the-Food-Consumption-Score-FCS-variable.pdf>.

5. Model shown in Table A1 (in the Annex).

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