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SUPPLEMENT ARTICLE

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Do non-maternal adult female household members influence child nutrition? Empirical evidence from Ethiopia

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Abstract

Child malnutrition is an enormous public health problem in low- and middle-income countries (LMICs). In this paper, we study the relationship between non-maternal adult female household members (AFHMs) and under-5 child nutritional outcomes using nationally representative Ethiopian Demographic and Health Survey data, 2016. Because most of the primary inputs that go into the production of child health are intensive in maternal time, having additional AFHMs may ease the time constraints of the child's mother. We use anthropometric measures such as height-for-age *z*-scores (HAZ) and weight-for-age *z*-scores (WAZ) to measure stunting and underweight, respectively, as objective indicators of child nutritional status. Among our sampled households, we find that 40% of the children are stunted, 18% severely stunted, 27% underweight and 8% severely underweight. Furthermore, about 20% of the sampled children live with at least one extra non-maternal AFHM. The multivariate regression results suggest that an additional AFHM is associated with significantly higher HAZ and WAZ scores and less likelihood of severe stunting compared with children living with fewer AFHMs. Finally, the paper discusses the potential pathways through which non-maternal AFHMs can influence child nutritional status.

KEYWORDS

anthropometric, child nutrition, Ethiopia, non-maternal adult female, stunting, underweight

1 | INTRODUCTION

In many low- and middle-income countries (LMICs), child malnutrition remains a significant health problem, whereas energy consumption has improved over the past decades (FAO et al., 2017). Childhood undernutrition has significant negative effects on long-term cognitive development and poor school performance, which yield lower adult economic productivity and a higher mortality risk (Black et al., 2008; Glewwe, Jacoby, & King, 2001; Humphrey, 2009). Undernourished children are also more susceptive to infections due to their weak immune systems. Altogether, undernutrition contributes to around 45% of all deaths among children under-5, mainly in LMICs (Black et al., 2013; IFPRI, 2017). The long-term consequences of poor child nutrition induce huge economic costs in LMICs (Dercon & Porter, 2014; Horton & Steckel, 2013; Victora et al., 2008).

Child survival, nutrition and health depend on a broad range of factors, including household food security, a healthy environment, the available health services, care provided to women and children and the socio-economic resources of the household (UNICEF, 1991). Studies show that environmental factors such as access to improved water and sanitation (WASH) are significant drivers of child growth outcomes (e.g. Fenn, Bulti, Nduna, Duffield, & Watson, 2012; Pickering &

Davis, 2012; Rah, Sukotjo, Badgaiyan, Cronin, & Torlesse, 2020; Spears, Ghosh, & Cumming, 2013; Usman & Gerber, 2020). For instance, Fenn et al. (2012) showed that WASH interventions reduce the prevalence of stunting by 12% in Ethiopia. Similarly, the findings by Lin et al. (2013) indicate that children living in households with improved sanitation and hygiene are taller for their age as compared with children living in an unhealthy environment. Adults living in the same home could influence the nutritional intake and hygiene and sanitary practices of young children.

The role of the primary caretaker in improving child nutrition has been well explored in the child development literature. However, the correlation between child nutrition and household family composition, specifically the role of other household members (e.g. siblings and grandmothers) living together, has mainly only been studied in high-income countries. Nevertheless, the context of households in LMICs, with higher levels of non-parental family members as well as temporary labour migration, is usually different from that in high-income countries (Lloyd & Desai, 1992; Ntshebe, Channon, & Hosegood, 2019). For instance, many children in Africa live in multi-generation households and with multiple (non-maternal) female caretakers (Ntshebe et al., 2019). In the Ethiopian sociocultural context, the involvement of grandmothers and older female siblings in the caretaking of young children is deeply rooted, in terms of feeding (directly or indirectly by guiding feeding practices such as breastfeeding for infants), child-rearing practices, caring, fetching water and collecting firewood (Gibson & Mace, 2005; Jo, 2009).

There are multiple pathways through which household family composition could affect child nutrition and health outcomes, both directly and indirectly through the socio-economic resources of the household. First, the more adult household members who generate an income, the more resources there are available. Therefore, the number of economically active household members to the number of dependent family members is associated with higher income and improved economic resources. Second, the role and empowerment of the primary caretaker to make nutrition-sensitive decisions is correlated with the proportion of female household members (to male members) as well as their relation to the head of the household. Many studies have shown that an increased level of empowerment of the female caretaker improves child nutrition and health (Cunningham et al., 2015; Malapit & Quisumbing, 2015; Na, Jennings, Talegawkar, & Ahmed, 2015; Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). Lastly, the household family composition is vital to the provision of kin support, which increases the care time children receive (Popkin, 1980) and the care knowledge mobilization within the household. Both of these have been identified as essential determinants of the nutritional status of children (e.g. Singh et al., 2018).

In this paper, we focus on the importance of non-maternal adult female household members' (AFHMs) support to child nutrition through their effects on child care in a low-income country, namely, Ethiopia, where child undernutrition is among the highest in the world. In the UNICEF (1991) conceptual framework, care is defined as 'the provision in the household and the community of time, attention and support to meet the physical, mental, and social needs of the growing child and other household members'. The kin support literature argues that other household members, for example, relatives, support mothers by taking care of young children or taking over the mother's domestic tasks. Previous studies suggest that among the relatives, grandmothers have an important role in children's growth and development because they often provide special treats and affection to their grandchildren (Aubel, 2012; Black & Nitz, 1996; Gibson & Mace, 2005; Schrijner & Smits, 2018; Sharma & Kanani, 2006) and also contribute to improved maternal knowledge (Aubel, 2012; Karmacharya, Cunningham, Choufani, & Kadiyala, 2017). Among those studies, however, there is a gap concerning stunting and underweight as outcome variables. To our knowledge, none of these studies have looked at the Ethiopian context.

We use multivariate regression to empirically test whether having extra non-maternal AFHMs improves the nutritional outcomes of under-5 children in Ethiopia. We hypothesize that children living with extra AFHMs are better off in terms of anthropometric indicators, although household size with a high dependency ratio may negatively affect child nutrition (e.g. Pelto et al., 1991). The data for this study come from the standard Demographic and Health Survey (DHS) of Ethiopia, 2016. The DHS is a nationally representative cross-sectional data, which contains information on child anthropometric measurements (such as height and weight) and several socio-economic and demographic variables that could potentially influence child nutrition and well-being.

Key messages

- We study the relationship between non-maternal adult female household members (AFHM) and under-5 child nutrition using the Demographic and Health Survey data.
- About 40% of the sampled children are stunted, 18% severely stunted, 27% underweight, and 8% severely underweight.
- One-fifth of the sampled children live with at least one extra non-maternal adult female member. Having an additional non-maternal AFHM is significantly associated with higher height-for-age and weight-for-age z-scores and less likelihood of severe stunting.

2 | METHODS

2.1 | Data source

We use the most recent available data from the 2016 Ethiopian DHS. The DHS is a nationally representative sample survey and

uses a stratified two-stage cluster design sampling methodology. Details of the survey can be found in the final report (CSA & ICF International, 2017, for more information on DHS sampling methodology). The survey collects a wide range of information on socio-demographic, child health and nutrition as well as other topics. Our sample includes both urban and rural households with children aged 6–59 months. Previous empirical studies guide the selection of variables in the multivariate analysis (e.g. Usman, Gerber, & von Braun, 2019; van Cooten, Bilal, Gebremedhin, & Spigt, 2019).

2.2 | Child anthropometric

The DHS collects the height and weight of all under-5 children registered in the household roster. Child age was determined by the birth certificate or maternal report of age. Anthropometric measurements are often used as indicators to measure nutritional status for under-5 children. Based on height and weight measures, sex-specific anthropometric indices of height-for-age *z*-scores (HAZ) and weight-for-age *z*-scores (WAZ) were computed for each child based on the new WHO child growth standards (WHO Multicentre Growth Reference Study Group, 2006). The *z*-score is calculated as $z_i = \delta_y^{-1}(y_i - y_{50})$ where y_i is the anthropometric outcome, y_{50} is the median of the WHO reference population and δ_y is the standard deviation (SD) of the WHO reference populations. The new child growth standards are computed from children who were fed and raised under favourable environments in different countries of the world, regardless of any social and economic influences. The *z*-scores indicate the number of SD a child is below or above the standard for his/her age in comparison with the reference growth standards.

The evaluation based on the anthropometric measure identifies children that are at increased risk of faltered growth. To be classified as stunted or underweight, the child is at least −2 SD below the median of the WHO child growth standards. Similarly, severely stunted or severely underweight is defined as HAZ or WAZ < −3 SD, respectively. These indices were pre-existing variables in the DHS dataset. A low WAZ (underweight) is used as an indicator for both chronic and acute forms of malnutrition (Gray, Cossman, & Powers, 2006). In contrast, a low HAZ (stunting) is a cumulative indicator of slow physical growth and reflects long-term malnutrition (Currie & Vogl, 2013; Glewwe et al., 2001).

2.3 | Child characteristics

Primary caretakers were asked to report the sex of their child, the birth order of the child and its age in months. Additionally, information on whether a child is a singleton or from a multiple birth was available, but we excluded this information in the multivariate regression because around 98% of the children are singleton. In this analysis, we only included children living with their biological mothers and with non-single-parent household.

2.4 | Maternal variables

Information on the age of the mother in years, the level of formal education completed and her occupation in the 12 months previous to the survey was available in the data. Additionally, height and weight were measured, and the body mass index (BMI) was calculated and categorized into underweight, normal and overweight based on the international classifications. Short stature was defined as height less than or equal to 147 cm.

2.5 | Adult female characteristics

The average number of AFHMs in the sample was about 1.16, with some households having up to four AFHMs. In terms of composition and relationship to the household head, the adult females include daughters, spouses, sisters, parents, parents-in-law, daughters-in-law, grandchildren and other unrelated household members (Figure 1). Some of the non-maternal AFHM characteristics, such as average age and education level, are highly correlated with maternal age and education level, respectively. As a result, in the multivariate analysis, the models are adjusted only for maternal age and education level to reduce multicollinearity.

2.6 | Household variables

A wealth index for each household was generated based on several assets and other variables. Details on the wealth computation are available in the final report of the survey (CSA & ICF International, 2017). Access to improved water supplies and sanitation facilities and distance to the drinking water source were included as confounders for child nutrition outcomes. Additionally, the head of the household's level of education and occupation were available, but we exclude them in the multivariate analysis as they are highly correlated with maternal education and occupation, respectively. Lastly, we also include whether the child is living in a rural or urban area.

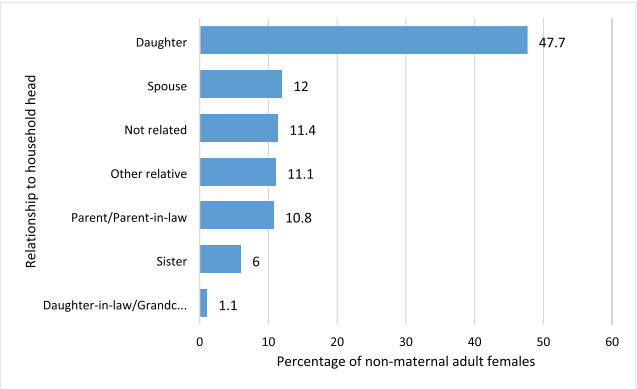

FIGURE 1 Composition of non-maternal adult female household members and their relationship to household head

2.7 | Statistical analysis

We considered the following outcomes: prevalence of stunting (HAZ < −2), severe stunting (HAZ < −3), underweight (WAZ < −2) and severe underweight (WAZ < −3). In addition to the binary outcomes of children's nutritional status, we considered the *z*-scores as a continuous variable for both HAZ and WAZ outcomes. Bivariate analysis was used to identify factors associated with child nutrition at $p < 0.05$, without adjusting for confounders. To test the association of the number of AFHMs with each outcome of interest, we estimated the adjusted odds ratio (AOR) using multivariate regression. The data analysis was performed using STATA version 16.1 (StataCorp LP, College Station, TX).

2.8 | Ethical considerations

Informed consent was obtained from all the study participants, and the ethical procedure of the survey has been published in the survey report (CSA & ICF International, 2017). The survey datasets that were used for this analysis did not include any variables allowing the identification of individuals.

3 | RESULTS

3.1 | Descriptive statistics

The descriptive statistics are reported in Table 1. The sample included over 7100 children aged 6–59 months whose mothers live in the same household. The summary statistics show that about 40% of children are stunted, 18% severely stunted, 27% underweight and 8% severely underweight. This result suggests that the rate of child undernutrition prevalence in Ethiopia is generally high as per the WHO risk clarification. The child characteristics show that at least 51% of children in the sample are male, the average age of children in the sample is 32 months and approximately one third of the children are either first or second births. About 12% of the sampled children had experienced diarrhoea in the 2 weeks preceding the survey.

The average age of the non-maternal AFHMs is about 30 years, which is equivalent to the average age of the child's mother. In terms of educational attainment, more than half of AFHMs do not have any formal education (Figure 2). Approximately 48% of the non-maternal AFHMs are daughters of the household head (Figure 1).

The majority of the mothers do not have any education or any formal occupation. Only 10% of the mothers and 16% of their husbands have completed secondary or higher education levels. About two thirds of the mothers have a healthy BMI between 18.5 and 25. Agriculture is the main livelihood activity among the study population, which may not be surprising, given that 82% of the sample are from rural households. Finally, as per the Joint Monitoring Programme (JMP) classification, the majority (61%) of the households have access to improved drinking water sources; however, more than half of the sampled households have to travel 30 min or more to get to these water sources. Only 17% of the households have access to improved sanitation.

3.2 | Bivariate analysis

Table 2 reports the bivariate logistic analysis between child undernutrition and socio-economic and demographic characteristics. The results suggest a significant difference in child undernutrition by sex, age and birth order of the children—for example, boys and children with a higher birth order are more likely to have inferior nutritional outcomes than their counterparts. The prevalence of undernutrition also varies according to the child's age. Although undernutrition increases with a child's age, it gradually decreases after the age of 3 or more (Figure 3). Children who had diarrhoea in the previous 2 weeks before the survey are more likely to be severely underweight. The variation in child undernutrition based on the mother's age group is only marginally significant for severe stunting. On the other hand, children born to overweight or taller mothers are more likely to have improved nutrition than children born to underweight or shorter mothers. The prevalence of child undernutrition also decreases with the number of non-maternal AFHMs living in the household (Figure 4).

The bivariate analysis also suggests that the occupation and the level of education of the mother or household head are important determinants of child undernutrition in Ethiopia. Children born to mothers whose main occupation is agriculture or are living with household heads engaged in agriculture are slightly more likely to be stunted or underweight. There is also a marked difference in the prevalence of child undernutrition by the household's access to improved drinking water and sanitation facilities. Specifically, children from households with improved drinking water sources and sanitation facilities are more likely to have better nutrition outcomes than children of families without improved water sources and sanitation. Similarly, children from households without on-premises water sources are more likely to be stunted or underweight. The variation in child undernutrition can also be influenced by the status of the household's wealth. In the DHS, household wealth is a composite index based on the household's ownership of selected assets (CSA & ICF International, 2017, for detailed information on the construction of the wealth index). Children living in households of the lowest wealth quintile are more likely to be underweight than children living in households of the highest wealth quintile. High household wealth could be associated with improved diet and better access to health services, which in turn can improve children's growth outcomes. Finally, children living in rural areas are three times more likely to be severely stunted (or underweight) compared with children living in urban areas. Caution is required with these results as they are merely correlations without considering all other confounding factors.

TABLE 1 Summary statistics

	Obs.	Mean	SD	Min	Max
Stunting—Yes = 1	7224	0.40	0.49	0	1
Severe stunting—Yes = 1	7224	0.18	0.38	0	1
Height-for-age z-scores	7224	−1.53	1.66	−6	6
Underweight—Yes = 1	7268	0.27	0.44	0	1
Severely underweight—Yes = 1	7268	0.08	0.27	0	1
Weight-for-age z-scores	7268	−1.30	1.22	−6	4
Child is female—Yes = 1	7352	0.49	0.50	0	1
Child age in months	7352	31.66	15.67	6	59
Third or higher birth—Yes = 1	7352	0.65	0.48	0	1
Diarrhoea in the past 2 weeks—Yes = 1	7341	0.12	0.32	0	1
Number of under-5 children	5383	1.68	0.74	1	6
Number of non-maternal AFHMs	5383	1.16	0.44	0	4
Number of non-maternal AFHM per under-5 children	5383	0.82	0.47	0	4
Non-maternal AFHMs' average age	5349	29.83	6.72	18	59
Female-headed households—Yes =1	5370	0.15	0.36	0	1
Mother's age in years	5383	29.55	6.70	15	49
Mother's height in cm	5327	157.97	6.79	81	189
Mother's BMI[a]					
Normal	5327	0.67	0.47	0	1
Underweight	5327	0.24	0.43	0	1
Overweight	5327	0.09	0.29	0	1
Mother's education level					
No education	5370	0.63	0.48	0	1
Primary	5370	0.26	0.44	0	1
Secondary or higher	5370	0.10	0.30	0	1
Mother's occupation					
No occupation	5383	0.58	0.49	0	1
Agriculture	5383	0.21	0.41	0	1
Sales	5383	0.11	0.31	0	1
Others	5383	0.11	0.31	0	1
Husband's education level					
No education	5359	0.48	0.50	0	1
Primary	5359	0.36	0.48	0	1
Secondary or higher	5359	0.16	0.37	0	1
Husband's occupation					
No occupation	5286	0.09	0.29	0	1
Agriculture	5286	0.55	0.50	0	1
Sales	5286	0.08	0.27	0	1
Others	5286	0.28	0.45	0	1
Improved water source—Yes = 1	5383	0.61	0.49	0	1
Minutes to water source					
On-premises	5360	0.17	0.38	0	1
≤30	5360	0.48	0.50	0	1
31–60	5360	0.19	0.39	0	1
60+	5360	0.16	0.37	0	1
Improved sanitation—Yes = 1	5383	0.17	0.37	0	1

(Continues)

TABLE 1 (Continued)

	Obs.	Mean	SD	Min	Max
Rural—Yes = 1	5383	0.82	0.39	0	1
Wealth index					
Poorest	5383	0.34	0.47	0	1
Poorer	5383	0.18	0.38	0	1
Middle	5383	0.15	0.36	0	1
Richer	5383	0.13	0.34	0	1
Richest	5383	0.20	0.40	0	1

Abbreviations: AFHMs, adult female household members; BMI, body mass index; SD, standard deviation.
[a]The data show that around 2% of the mothers are obese, but we combined them with the overweight category.

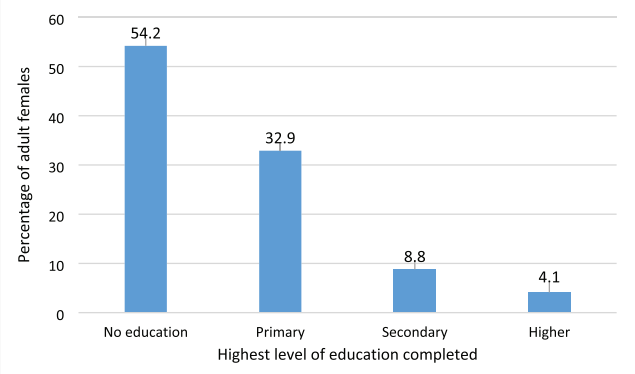

FIGURE 2 The highest level of education completed for adult female household members, including the mothers of the children

3.3 | Multivariate analysis

Having investigated the bivariate correlations between child nutrition and socio-economic and demographic variables, this section used multivariate regressions to control various confounding factors simultaneously. Based on previous empirical studies, we have included a wide range of child, maternal and household-level characteristics in the multivariate regressions. Several of these variables are key determinants of child health and nutrition outcomes. The models are adjusted for stratification and clustering to account for the complex DHS survey design.

Tables 3 and 4 summarize the estimates of the odds of a child being stunted or underweight, severely stunted or severely underweight. In Table 3, the results are based on the number of AFHMs in the household. Because over 40% of households have more than one under-5 child, the number of non-maternal AFHMs per household may not be a good indicator. To account for this, we measured the number of non-maternal AFHMs relative to the number of under-5 children, and the results are presented in Table 4. Both the results reported in Tables 3 and 4 are comparable, but the estimated effect sizes are relatively large in Table 4.

As can be seen in Table 4, the association between the number of non-maternal AFHMs and the probability of a child being severely stunted is statistically significant. This relationship is also robust after the models are adjusted for maternal and household-level characteristics (column 2, Table 4).

Next, we estimated the relationship between child nutrition measured by HAZ and WAZ and the number of non-maternal AFHMs using ordinary least squares, and the results are summarized in Table 5. Again, the number of AFHMs per child is independently associated with HAZ and WAZ. For instance, having an additional non-maternal AFHM is associated with, on average, a 0.22 unit of SD increase in height or 0.10 unit of SD increase in weight, after controlling for potential confounders (columns 3 and 4, Table 5).

4 | DISCUSSION

We analyse the association between AFHMs and under-5 child nutrition outcomes using nationally representative data from the DHS. In this sample of children living with their mothers, about 20% of them are living with at least one additional non-maternal AFHM. The empirical findings suggest that having additional AFHMs is positively and strongly associated with improved HAZ and WAZ and a lower prevalence of severe stunting among children aged 6–59 months.

It is worth pointing out that child nutrition can be affected by various socio-economic factors. The UNICEF (1991) conceptual framework lays out the immediate, underlying and basic determinants of child nutritional outcomes. The framework identifies that undernutrition occurs not only because of inadequate intake of nutrients, insufficient health care services and an unhealthy environment but that also a lack of adequate care can affect the nutritional status of a child. However, most of these inputs are maternal time intensive such as collecting clean water, preparing and cooking nutritious food and taking children for preventive health visits. If the mother (primary caretaker) of the child is time constrained, the supply of these inputs may be scarce and can result in children failing to grow and develop satisfactorily.

There are various mechanisms through which non-maternal AFHMs (e.g. siblings, aunts, grandmothers and other related and unrelated members of the household) can influence young children's nutrition outcomes. First, studies show that grandmothers play an essential role in children's well-being and development. They (commonly referred to as secondary caregivers) often provide special treats

TABLE 2 Unadjusted risk of undernutrition and bivariate regression analysis

Characteristics		Obs. (%)	Stunting	Severe stunting	Underweight	Severe underweight
Sex	Male	3763 (51.2)				
	Female	3589 (48.8)	0.88**	0.87*	0.88*	0.98
Age group	6–12	1098 (14.9)				
	13–24	1590 (21.6)	3.36**	3.41**	1.92**	1.79**
	24+	4664 (63.4)	3.87**	4.21**	2.17**	1.78**
Birth order	First/second birth	2582 (35.1)				
	≥ Three	4770 (64.9)	1.30**	1.54**	1.41**	1.66**
Diarrhoea	No	6464 (88.1)				
	Yes	877 (11.9)	1.06	1.03	1.21*	1.42**
HH head sex	Male	6225 (84.7)				
	Female	1127 (15.3)	0.93	0.96	1.07	1.21
Mother's age	≤24	1670 (22.7)				
	25–34	3885 (52.8)	1.04	1.19*	1.00	1.05
	34+	1897 (24.4)	1.15*	1.23*	1.06	0.97
Mother's BMI	Normal	4856 (66.7)				
	Underweight	1766 (24.3)	1.12*	1.20**	1.63**	1.74**
	Overweight	651 (9.0)	0.43**	0.44**	0.40**	0.32**
Mother's height	Tall stature	7063 (96.1)				
	Short stature	289 (3.9)	2.03**	1.97**	1.71**	1.58*
Mother's education	No education	4830 (65.7)				
	Primary	1856 (25.2)	0.76**	0.66**	0.57**	0.48**
	Secondary or higher	666 (9.1)	0.34**	0.18**	0.26**	0.20**
Mother's occupation	No occupation	4357 (59.3)				
	Agriculture	1508 (20.5)	1.37**	1.24**	1.22**	1.06
	Sales	771 (10.5)	0.81**	0.71**	0.65**	0.50**
	Others	716 (9.7)	0.83*	0.74**	0.63**	0.59**
Head's education	No education	3624 (49.5)				
	Primary	2580 (35.3)	0.82**	0.75**	0.66**	0.60**
	Secondary or higher	1113 (15.2)	0.46**	0.34**	0.43**	0.45**
Husband's occupation	No occupation	729 (10.1)				
	Agriculture	3997 (55.3)	1.58**	1.44**	1.24*	1.02
	Sales	554 (7.7)	0.78*	0.66*	0.56**	0.42**
	Others	1948 (27.0)	0.93	0.73*	0.72**	0.64**
Water source	Unimproved	2994 (40.7)				
	Improved	4358 (59.3)	0.87**	0.78**	0.79**	0.71**
Time to water source in minutes	On-premises	1162 (15.9)				
	≤30	3513 (48.0)	2.16**	2.86**	2.32**	2.73**
	31–60	1421 (19.4)	2.35**	3.16**	2.75**	3.79**
	60+	1220 (16.7)	2.19**	3.23**	2.96**	4.17**
Sanitation	Unimproved	6177 (84.0)				
	Improved	1175 (16.0)	0.44**	0.33**	0.38**	0.40**
Region	Urban	1229 (16.7)				
	Rural	6123 (83.3)	2.11**	3.21**	2.54**	2.92**
Wealth index	Poorest	2664 (36.2)				
	Poorer	1333 (18.1)	1.10	1.02	0.85*	0.76*
	Middle	1095 (14.9)	0.84*	0.65**	0.63**	0.45**

(Continues)

TABLE 2 (Continued)

Characteristics		Obs. (%)	Stunting	Severe stunting	Underweight	Severe underweight
	Richer	919 (12.5)	0.71**	0.54**	0.41**	0.30**
	Richest	1341 (18.2)	0.42**	0.24**	0.26**	0.17**

Note: Coefficients are odds ratios.
Abbreviations: BMI, body mass index; HH, household.
*$p < 0.05$; **$p < 0.01$.

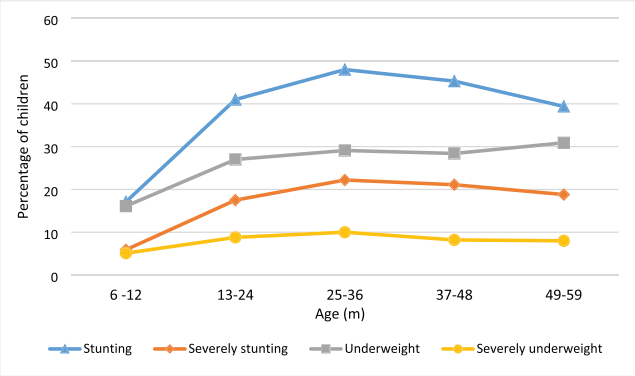

FIGURE 3 Percentage of children stunted, underweight and severely (stunted) underweight across age categories

and affection to their grandchildren that can influence the child's survival and nutritional outcomes (e.g. Aubel, 2012; Chung et al., 2020; Gibson & Mace, 2005; Schrijner & Smits, 2018; Sharma & Kanani, 2006). In a related manner, young mothers may also learn from the grandmothers the skills and knowledge required to provide adequate care for their child. Nevertheless, it is also important to note that the realization of these positive effects depends on the amount of time grandparents spend with their grandchildren or young mothers (Pulgaron, Marchante, Agosto, Lebron, & Delamater, 2016).

Second, in many low-income countries such as in Ethiopia, where this study was carried out, women and girls disproportionately carry the burden of water collection or cooking for the family. For example, adult women are 10 times more likely to collect water for household consumption than adult men (e.g. CSA & ICF International, 2017; Usman, Gerber, & Pangaribowo, 2018). Around 83% of the sampled households do not have drinking water sources on-premises—suggesting that the daily chore of fetching water takes considerable time and energy. A study in rural Kenya estimates that, on average, a household makes seven water-fetching trips per day, with each trip requiring a 20-min walk on average (Kremer, Leino, Miguel, & Zwane, 2011). This has some health implications for both the mother and the child. Therefore, having additional AFHMs allows the primary caretaker to spend more time taking care of her child, preparing healthy food and engaging in other income-generating activities (Cairncross & Cliff, 1987; Sorenson, Morssink, & Campos, 2011). Also, non-maternal AFHMs can support the mother during her pregnancy and lactation period, which has a direct implication on the child health and nutritional outcomes.

Generally, besides feeding practices, sanitary environment and health care, young children also need adequate care for optimal growth and development (Engle, Menon, & Haddad, 1999; UNICEF, 1991). Most of these inputs can only be supplied in sufficient quantity or quality to a child if the mother is endowed with enough time and energy. The presence of non-maternal AFHMs helps to bridge the possible constraints in the provision of these inputs.

Prior research in Ethiopia has suggested that grandmothers had a significant positive effect on child survival. They had a beneficial effect on child height as they relieve young mothers of heavy domestic tasks (Gibson & Mace, 2005). Similarly, the role of adult female

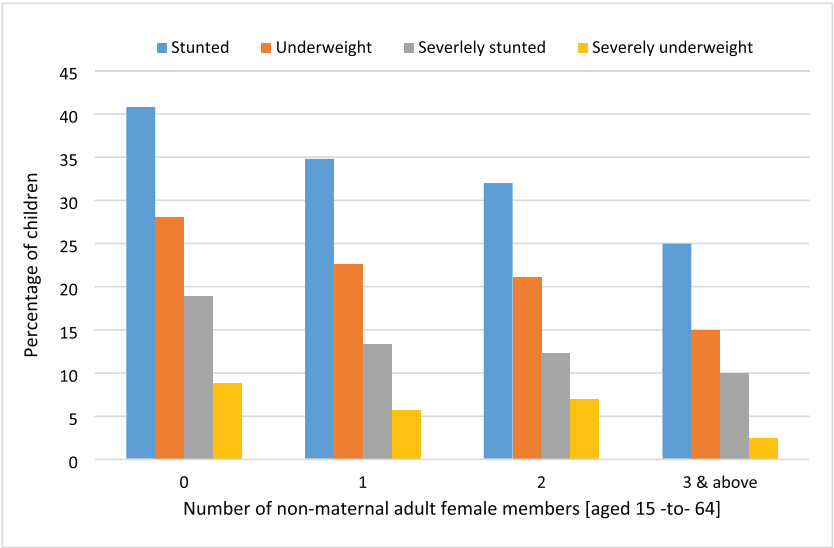

FIGURE 4 Prevalence of child undernutrition by the number of non-maternal adult female household members

TABLE 3 Odds of being stunted, severely stunted, underweight and severely underweight

	(1)	(2)	(3)	(4)
	Stunting	**Severe stunting**	**Underweight**	**Severe underweight**
Panel A				
Number of non-maternal adult females [age 15–64]	0.895 [0.074]	0.709*** [0.074]	0.911 [0.080]	0.680* [0.136]
N	7224	7224	7268	7268
Panel B				
Number of non-maternal adult females [age 15–64]	0.971 [0.084]	0.768** [0.083]	0.967 [0.089]	0.731 [0.147]
N	7145	7145	7189	7189
Panel C				
Number of non-maternal adult females [age 15–64]	0.997 [0.087]	0.802** [0.087]	1.000 [0.093]	0.758 [0.157]
N	7110	7110	7154	7154

Note: All models are adjusted for the cluster survey design. Standard errors in brackets. Panel A is adjusted for child-level covariates: sex, age, birth order and number of children aged 7 or younger. Panel B is adjusted for child- and maternal-level covariates (mother's age, level of education, stature, body mass index and occupation). Panel C is adjusted for child-, maternal- and household-level covariates (wealth quintiles, access to improved drinking water, sanitation and distance to water sources and urban/rural residence).
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 4 Odds of being stunted, severely stunted, underweight and severely underweight

	(1)	(2)	(3)	(4)
	Stunting	**Severe stunting**	**Underweight**	**Severe underweight**
Panel A				
Number of non-maternal adult females per under-5 children	0.812** [0.082]	0.576*** [0.076]	0.800* [0.093]	0.607* [0.160]
N	7224	7224	7268	7268
Panel B				
Number of non-maternal adult females per under-5 children	0.897 [0.093]	0.642*** [0.086]	0.863 [0.100]	0.676 [0.177]
N	7145	7145	7189	7189
Panel C				
Number of non-maternal adult females per under-5 children	0.935 [0.098]	0.686*** [0.091]	0.903 [0.104]	0.723 [0.190]
N	7110	7110	7154	7154

Note: All models are adjusted for the cluster survey design. Standard errors in brackets. Controls are the same as Table 3.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

siblings in preventing and mitigating household hardship is similar to that of mothers, particularly in rural Ethiopia (Jo, 2009). Culturally, fetching water, collecting firewood and cooking activities are often attributed to adult female members in rural communities. Most of the primary inputs that go into the production of child health (nutrition) are intensive in maternal time. Child malnutrition is more prevalent in rural areas than in urban areas because of the low quality of child care (Smith, Ruel, & Ndiaye, 2005). In view of this, the presence of non-maternal AFHM is thus vital in relieving the mothers of heavy domestic tasks. Hence, mothers have more time and energy to allocate to essential inputs for the well-being of a child. In addition to their role of easing the burden of heavy domestic chores and other activities, young adult members in Ethiopian families also participate in income-generating activities and contribute to family livelihoods, an essential ingredient for the production of child health and well-being (Abebe, 2007). Given that most of the AFHMs in our study sample are of middle age (see Figure 5), they could support child nutrition indirectly by participating in income-generating activities. By doing so, AFHMs may play a vital role in buffering younger household members from the adverse effects of livelihood insecurity.

4.1 | Study limitation

One of the main limitations of this study is that due to the cross-sectional nature of the data and other unmeasured confounders, a causal relationship between non-maternal adult females and child nutrition cannot be established. The results of the multivariate

TABLE 5 Multivariate regression for height-for-age and weight-for-age z-scores

	(1) Height-for-age z-scores	(2) Weight-for-age z-scores	(3) Height-for-age z-scores	(4) Weight-for-age z-scores
Panel A				
Number of non-maternal adult females [age 15–64]	0.234*** [0.074]	0.126*** [0.048]		
Number of non-maternal adult females per under-5 children			0.336*** [0.069]	0.197*** [0.051]
Child characteristics	Yes	Yes	Yes	Yes
N	7224	7268	7224	7268
Panel B				
Number of non-maternal adult females [age 15–64]	0.171** [0.072]	0.077 [0.047]		
Number of non-maternal adult females per under-5 children			0.255*** [0.066]	0.135*** [0.050]
Child characteristics	Yes	Yes	Yes	Yes
Mother characteristics	Yes	Yes	Yes	Yes
N	7145	7189	7145	7189
Panel C				
Number of non-maternal adult females [age 15–64]	0.148** [0.073]	0.054 [0.048]		
Number of non-maternal adult females per under-5 children			0.219*** [0.067]	0.103** [0.049]
Child characteristics	Yes	Yes	Yes	Yes
Mother characteristics	Yes	Yes	Yes	Yes
Household-level characteristics	Yes	Yes	Yes	Yes
N	7110	7154	7110	7154

Note: All models are adjusted for the cluster survey design. Standard errors in brackets. Controls are the same as Table 3.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

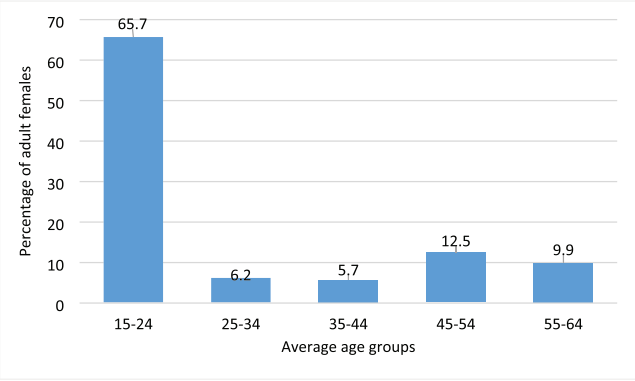

FIGURE 5 Distribution of adult female household member by age group

regressions are adjusted for potential observable confounders, which are likely to be correlated with both child nutrition and non-maternal AFHMs. Nevertheless, there are unobserved confounders that could not be accounted for but are potentially associated with child nutrition and/or AFHMs. This analysis would also have benefited if we had taken a child's birthweight into account because studies show that children who are small at birth are also more likely to be undernourished than children who are average or larger at birth (Harding, Aguayo, & Webb, 2018). However, for most children, birthweight information is missing in the data. Another limitation is the lack of data about the additional female adults in the household's behaviour in terms of caregiving and help with the chores.

5 | CONCLUSION

Ethiopia has made significant progress in reducing child undernutrition in the last two decades. Despite all the improvements achieved, the prevalence of undernourishment is still unacceptably high in the country. Using the recent 2016 DHS data, the results show that a substantial share of children in Ethiopia are too short or thin for their age compared with the WHO child growth standard.

This analysis contributes to the limited literature on the role of AFHMs in improving child nutrition outcomes. Because most of the inputs that go into the production of child health are maternal time intensive, having additional AFHMs in the households may allow the child's mother to spend more time cooking nutrient-rich foods and to spend more time with the child, which is crucial for child growth and healthy lives. Relatedly, the non-maternal AFHMs may take over most

of the household chores, therefore reducing the mother's workload and time constraints.

Furthermore, the study reaffirmed some of the links that have already been established between various socio-economic variables (e.g. maternal characteristics, WASH and wealth among others) and child nutrition outcomes. Further research may be required to examine the mechanisms through which non-maternal AFHM in the household affects child nutrition outcomes—for example, determining the amount of time spent on various activities (homemaking, food preparation, child-caring). Future analyses should also consider stratifying the non-maternal AFHMs into a younger versus older or more senior women to see the effect that has on child nutrition.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

MAU and LK designed the research study. MU performed the statistical analysis and drafted the manuscript. LK and TGS critically revised the manuscript. All authors contributed to and approved the final version of the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available at https://www.dhsprogram.com/data/available-datasets.cfm.

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