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Factors Affecting the Nutritional Status of School-aged Children Belonging to Farming Households in the Philippines

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Undernutrition among school-aged children continues to be a public health concern in the Philippines, where agriculture is the primary source of income. School-age is a crucial phase of development and growth among children since it can establish nutritional knowledge and healthy eating habits across the next life stages. Evidence suggested that undernutrition exists among school-aged children belonging to households relying on agriculture. This study aims to identify factors affecting the nutritional status of school children belonging to farming households. The data set from the 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups of the Department of Science and Technology–Food and Nutrition Research Institute (DOST-FNRI) consisting of 1,689 school children belonging to farming households was used in this study. Multiple logistic regression was used to determine significant factors affecting the nutritional status of school-aged children while holding other variables constant. Household wealth index and age were significantly associated with underweight and wasting. Meanwhile, poor dietary diversity score was also an essential confounding factor between socioeconomic status with underweight and stunting but not wasting. The study's findings can provide empirical evidence that the most important underlying causes of undernutrition among school-aged children belonging to farming households were wealth index and food availability. It is recommended that their investments be made in addition to livelihood for families relying on agriculture and provide them better access to government services to diminish the existing issues of scarcity.

Keywords: farming households, nutritional status, school-aged children

INTRODUCTION

School-age is a dynamic phase of active growth and mental development of childhood (LeMone *et al.* 2015). Therefore, this age group's nutritional needs are higher than the preschool years to sustain the approaching growth spurt, requiring diets high in macro and micronutrients (Sawyer *et al.* 2012; FAO-WHO-UNU 2001). Due to the increased nutrient needs to sustain the requirement, malnutrition among this age group remains a significant public health problem in developing countries (Best *et al.* 2010). Globally, more than 200 million school children are suffering from malnutrition, particularly stunting, and it is expected that the number will increase by five folds if no intervention is made (UNICEF 2011, 2012).

Studies from Africa, India, Zambia, and the Philippines suggest that a higher proportion of undernourished school-

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aged children were observed in rural areas, particularly among households relying on agriculture (Lawal and Lawal 2010; Gillespie *et al*. 2012; Capanzana *et al.* 2018). The agriculture workers and their families are among the most vulnerable groups because of their dependence on different climatic factors that affect their produce and harvest. Farming households in rural areas tend to be poorer than their urban counterparts (Baiphethi and Jacobs 2009). Meanwhile, larger households with lower economic status belonging to the agricultural sector demonstrated an even worse nutrition situation among school-aged children. In a study conducted by Bhagowalia (2012), households belonging to the farming sector tend to have slightly higher prevalence of wasting and stunting than their non-farming counterparts. In the Philippines, agriculture workers – including farmers, fishermen, and foresters – recorded the highest incidence of poverty (PSA 2016).

Based on the United Nations Children's Fund (UNICEF 2016) report, undernutrition among school-aged children continues to be a public health concern in most ASEAN countries. Higher prevalence was still recorded in the Philippines, Myanmar, and Laos (WHO 2008). In the Philippines, undernutrition among this age group remains a significant public health concern (Capanzana and Aguila 2020). Based on the 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups of the DOST-FNRI, underweight (31.2%), stunting (31.1%), and wasting (8.4%) among school-aged children 5–10 yr old were considered a significant public health problem. There was an observed increment in the prevalence of underweight of 2.1% and stunting of 1.3%, respectively, compared to the 2013 national estimates. Meanwhile, the prevalence of wasting remains unchanged from 8.6% (2013) to 8.4% (2015) (FNRI 2016a).

Studies suggest that school-aged children were among the most at-risk groups for undernutrition due to dietary inadequacy, food inaccessibility, unequal household food allocation, improper preparation and storage of food, and presence of infectious diseases (Bain *et al.* 2013). These factors can be amplified by the interplay of different biological factors, economy, culture, environmental problems, and diseases. The interaction of these factors resulted in a higher prevalence of undernutrition among school-aged children (Degarege *et al.* 2015).

Evidence suggests that undernutrition during the school years can hinder the physical and cognitive development of a child. Malnutrition affects the academic performance of school-aged children due to delayed physical and mental development associated with school drop-out and late or non-enrollment, high absenteeism, and unsatisfactory performance in school (Jensen 2009; Pasricha and Biggs 2010). Undernutrition during school-aged years may also compromise the health and survival of future generations (Best *et al.* 2010; UNICEF 2013).

The existence of the COVID-19 pandemic may exacerbate the nutrition situation of this vulnerable group because of food system disruption and the diminishing impact of public health interventions (WB 2020). The biggest dilemma of the COVID-19 food crisis is not due to scarcity of resources particularly the staple commodities, but these are the hurdles of logistics of commodities from farms to consumers (Cullen 2020). Thus, there is a need to review policies concerning food insecurity, hunger, and undernutrition to reduce inequity by working on policies for sustainable food systems to make healthy foods accessible to vulnerable groups, including farming households, during the pandemic or even after it (Ong *et al.* 2020). Hence, this paper intends to estimate the prevalence of undernutrition among school-aged children and determine significant factors that affect school-aged children's nutritional status in farming households. This study can serve as a basis in planning and developing programs that can specifically target the farming sector. Lastly, this study can also provide crucial information on the factors affecting the nutritional status of school-aged children that will guide policymakers and stakeholders to craft policies and initiatives that can improve the situation of school-aged children belonging to farming households.

METHODOLOGY

Study Design Participants

A cross-sectional study design was utilized in the 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups conducted by the DOST-FNRI. The national survey included the 17 regions and 80 provinces of the country. In this study, households with school-aged children aged 5.0–10.0 yr old were included. Among the 43,310 families participating in the survey, only 12,326 households qualified based on the identified classification set by the DOST-FNRI for farming households (FNRI 2016d; PSA 2012a). Based on the the12,326 farming households, only 6,578 (53.37%) households had school-aged children (5.08–10.0 yr old). After excluding households without dietary and food security assessments, 1,689 school children were included in the data analysis.

Data Collection and Processing

The data used in this study were obtained from the Nutrition Survey Data Public Use Files, which is accessible online for the public at the e-nutrition website of the DOST-FNRI. Access conditions were followed

in the conduct of this study. In addition, researchers for the conduct of 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups were trained on obtaining proper anthropometric measurements and proper conduct of face-to-face interviews (FNRI 2016a). As a result, the following data were collected:

Anthropometric measurement. A digital double window weighing scale was used to measure the weight of school children. Meanwhile, the standing height of school children was measured using a stadiometer. To assess the nutritional status of school-aged children ages 5.0–10.0 yr old, the WHO Growth Reference 2007 was used. It was analyzed using the WHO Anthro Plus 1.0.3. The nutritional status was categorized according to undernutrition indices: weight-for-height (0 = wasted; 1 = normal), height-for-age (0 = stunted; 1 = normal), and weight-for-age (0 = underweight; 1 = normal).

Household dietary diversity. The Household Dietary Diversity Guide was used, composed of 12 food groups to evaluate the household dietary diversity. The 12 groups were cereals, roots, and tubers; vegetables; fruits; poultry and meat; eggs; fish and other seafood; legumes; pulses; nuts; milk and milk products; oils and fats; sugar and honey; and beverages, spices, and condiments. A higher household dietary diversity score suggests a more varied diet, and the probability of meeting the nutrient requirement of household members was also increased. The household dietary diversity score was classified (0 = poor; 1 = borderline; 2 = acceptable).

Household food security status. Household Food Insecurity Access Scale (HFIAS) was used to evaluate the household food security status through a face-to-face interview. The HFIAS included nine questions with a 30-d reference period, which also probe for the frequency and severity of conditions experienced by the household. In this study, the household's food insecurity level surges with higher severity and increased frequency of occurrence. The household food security was categorized (3 = food secure: household does not experience any of the conditions or just rarely worries about food; 2 = mildly food insecure: a household sometimes or often worries about food, and/or is unable to eat preferred foods, and/or rarely experiences having to eat less varied foods and/or eat foods they do not want to eat; 1 = moderate food insecure: household sacrifices food quality, as it sometimes or often eats a less varied diet and/or undesirable foods, and starts to cut back on the number of foods by reducing the meal portion or the number of meals, rarely or sometimes; 0 = severely food insecure: household often cuts back the number of foods and experiences running out of food, going to sleep, hungry, and not eating for the whole day) (Coates *et al.* 2007).

Socio-demographic and economic data. Socio-demographic and economic data were also collected *via* face-to-face interviews. Data on age, parental educational attainment, and occupation were taken. Characteristics of household members and wealth index were collected for socio-economic status. The household wealth index of the farming families was classified by wealth quintile, a composite measure of a household's ownership of household assets – including televisions, bicycles, materials used for housing construction, and types of water access and sanitation facilities. The household wealth index was generated for each household asset and define wealth quintiles (0 = poorest; 1 = poor; 2 = middle; 3 = rich; 4 = richest).

Household living conditions. In this study, the living conditions of the households were defined using indicators such as type of housing unit, number of 0–10 children in the household, and fuel for cooking. Meanwhile, household health and sanitation were characterized by the type of latrine, sources of water for drinking and cooking, and garbage disposal practices.

Statistical Analyses

The data were analyzed using descriptive statistics to describe farming households' socio-demographic and economic characteristics. In addition, proportion estimates were used to describe the prevalence of undernutrition of school-aged children in farming households.

Meanwhile, the dependent variable was the nutritional status of school-aged children in farming households. The available socio-economic and demographic profiles of the school-aged children and their respective households were used as explanatory variables. Multiple logistic regression was used to determine which among these factors were significantly related. Specifically, the forward selection was used to identify the significant factors that can affect the nutritional status of the school-aged children while controlling the confounding effect of other intervening variables. An $\alpha = .05$ was used to determine if the different factors that affect the nutritional status of school-aged children.

Ethical Consideration

The Ethics Committee of the DOST-FNRI approved the conduct of this survey with the protocol number FIERC-2015-006. All surveyed households requested to give written informed consent before participation.

RESULTS

Socio-economic and Demographic Profile

Most (23.1%) of the study participants belonged to the age group between 7.01–8.0 yr old, and above half (51.6%) were male. Only a few of the participants belonged to a specific ethnic group in terms of ethnicity. Most households belonged to the poorest and poor quintile, while only a few (8.9 and 2.8%) belonged to the rich and richest quintile. Almost all (92.2%) were dual-headed households. Most head/father and caregivers/mothers only reached elementary school (64.2 and 54.2%, respectively). Almost all households had 5–9 members and > 9 members, respectively, wherein above half of the households had at least 1–2 children (Table 1).

Table 1. Socio-demographic and economic profile of school-aged children belonging to farming households, Philippines, 2015.

Demographic characteristics of the respondents	n = 1689	%
Mean age of school-aged children	7.59 ± 1.4	
Age		
5.0–6.0 yr old	301	17.8
6.01–7.0 yr old	315	18.7
7.01–8.0 yr old	390	23.1
8.01–9.0 yr old	327	19.4
9.01–10.03 yr old	356	21.1
Sex		
Male	871	51.6
Female	818	48.4
Ethnicity		
Belong to an indigenous group	213	12.6
Not belong to any indigenous group	1476	87.4
Household wealth index		
Poorest	811	48.1
Poor	464	27.5
Middle	215	12.7
Rich	150	8.9
Richest	47	2.8
Educational attainment of household head/ father	1085	64.2
Elementary level or graduate	502	29.7
Highschool level or graduate	45	2.7
College undergraduate	57	3.4
College graduate		
Educational attainment of mother/ caregiver		
Elementary level or graduate	915	54.2
Highschool level or graduate	599	35.5
College undergraduate	77	4.6
College graduate	98	5.8
Family type		
Single-headed family	132	7.8
Dual-headed family	1557	92.2
Household size		
< 5 members	229	13.6
5–9 members	744	44.1
> 9 members	716	42.4
Number of 0–10 yr old children in the household	937	55.5
1–2 children	653	38.7
3–4 children	99	5.9
> 5 children		

In terms of the type of dwelling, almost all (98.1%) of them lived in a single-unit household, and the majority (94.1%) used charcoal, wood, and other types of biomasses for cooking. Meanwhile, most of the households relied on dug and tube well for their water supply. Most of the households were not doing any technique to make their water safe to drink. Among sterilization households, the majority (15.2%) were boiling their water before using, while some (8.6 and 8.5%) used improvised filtration systems and chlorine, respectively.

Almost a quarter who did not own (21.4%) were not using an improved type of toilet facilities. The majority were using an open-pit toilet (63.3 and 71.1%, respectively). Most (63.3%) households owned an exclusive bathroom for the family and dumped their waste through an unorganized collection system. Among households, above half (53.6%) did not segregate their waste, while the majority (72.5%) did not use a compost pit system in disposing of their biodegradable wastes. Many (40.3%) were still burning their wastes as a disposal technique to eradicate their household wastes (Table 2).

Prevalence of Undernutrition among School-aged Children, Poor Household Dietary Diversity, and Food Security

Stunting among school-aged children was the most prevalent undernutrition at 43%, followed by underweight at 39.2% and wasting at 8%. About 30% of households with school-aged children households relying on agriculture were food secured. Meanwhile, the majority (39.6%) of farming households were experiencing mild food insecurity. With the food security status of households, only 19.0% among farming households with school-aged children had an acceptable household dietary diversity. In comparison, 8.1% of farming households with school-aged children had poor household dietary diversity. Details are shown in Table 3.

Factors Affecting the Nutritional Status of School-aged Children

Underweight was influenced by household wealth index, household size, and household dietary diversity status. As the wealth index improves, the risk of being underweight decreases. Households with > 9 members (OR: 2.1) and 6–8 members (OR: 1.4) had an increased risk of being underweight among school children belonging to farming households. Meanwhile, poor household dietary diversity (OR = 1.79) also increases the risk of being underweight among school-aged children from farming households (Table 4).

Table 2. Living conditions, WASH practices, and waste disposal system of farming households in the Philippines, 2015.

Living conditions and WASH practices	n = 1689	%
Type of dwelling		
Multi-unit/duplex	32	1.9
Single	1657	98.1
Fuel used in cooking		
Charcoal, wood, or biomass	1589	94.1
Natural gas or kerosene	6	0.4
Electricity or LPG	94	5.6
Source of potable water		
Surface water/ rainwater	9	0.5
Tanker truck or small cart	23	1.4
Spring	399	23.6
Dug and tube well	617	36.5
Piped well	460	27.2
Bottled or mineral water	181	10.8
Water sterilization		
No	1099	61.5
Yes	447	26.5
Bottled	143	8.5
Water sterilization technique used		
No sterilization made	1099	61.5
Solar/settling	33	2.0
Improvised filtration system	145	8.6
Filter sand and charcoal	12	0.7
Boiling	257	15.2
Chlorine	143	8.5
Type of latrine		
No toilet	361	21.4
Open-pit toilet	1112	65.8
Water-sealed toilet	216	12.8
Ownership of toilet		
No toilet	361	21.4
Public use toilet	15	0.9
Shared toilet	244	14.5
Exclusive toilet	1069	63.3
Waste disposal techniques		
Dumping		
Yes	1201	71.1
No	488	28.9
Burning		
Yes	681	40.3
No	1008	59.7
Compost pit		
No	1225	72.5
Yes	464	27.5
Collection system		
No	1476	87.4
Yes	213	12.6
Segregation		
No	905	53.6
Yes	784	46.4

In terms of stunting, the household wealth index increases the risk of stunting among school children belonging to farming households. It was also observed that household size with > 9 members and 6–8 members also increases the chance of being stunted among school-aged children belonging to farming households (OR= 1.9; OR= 1.36).

Table 3. Prevalence of undernutrition among school-aged children belonging to farming households with their food security and dietary diversity status in the Philippines, 2015.

Variables	Prevalence	95% confidence interval
Forms of undernutrition		
Underweight	39.2	36.9–41.6
Stunted	43.0	54.2–59.0
Wasted	8.0	6.8–9.4
Household food security status	27.7	25.6–29.8
Food secure	39.6	37.3–42.0
Mild food insecurity	13.6	12.1–15.3
Moderate food insecurity	19.1	17.3–21.1
Severe food insecurity		
Household dietary diversity		
Acceptable	19.0	17.2–20.9
Borderline	73.0	70.8–75.0
Poor	8.1	6.9–9.5

Meanwhile, the risk of being underweight among school-aged children was less likely to happen if the farming households experienced severe and moderate food insecurity (OR= 0.73 and 0.65). However, a poor dietary diversity score doubled the risk of being underweight among school-aged children from farming households while holding the other variables constant (OR = 1.98). Finally, only age significantly increased the risk of being wasted among school children belonging to farming households. It shows that the older children were more likely to be wasted compared to younger children. Details were shown in Table 4.

DISCUSSION

Demographic Profile of the Farming Households

Agriculture is the world's biggest employer and most significant economic sector across the globe, employing people from rural communities who produce 80% of the food for the whole population; however, they also constitute four-fifths of the global poor (Lu *et al.* 2015). This is consistent with the result of this present study, which revealed that most of the farming families belonged to the poorest wealth index. According to the Philippine Statistics Authority (PSA 2016), it was recorded that farmers, fishermen, and children that belong to families having income below the official poverty threshold recorded the highest incidence of poverty. Aside from the income irregularities of the agriculture sector workers, other factors still worsen their current situation. It includes issues on land ownership, debt, health and education access, and inadequate capital to finance the next cropping season. Moreover, the unresolved geographical and political

Table 4. Factors affecting the nutritional status of school-aged children belonging to farming households in the Philippines, 2015.

Factors	Stunting		Underweight		Wasting	
	Adjusted odds ratio (95% CI)	*p*-value	Adjusted odds ratio (95% CI)	*p*-value	Adjusted odds ratio (95% CI)	*p*-value
Household wealth index						
Poorest	12.32 (3.78–40.17)	< .001	6.29 (2.36–16.81)	< .001	–	–
Poor	10.00 (3.05–32.80)	< .001	4.14 (1.55–11.03)	0.004	–	–
Middle	6.63 (1.98–22.21)	0.002	3.11 (1.14–8.44)	0.026	–	–
Rich	5.32 (1.55–18.18)	0.008	2.71 (0.99–7.43)	0.053	–	–
Richest	1.00		1.00		–	–
Household size						
> 9 members	2.14 (1.57–2.91)	< .001	1.85 (1.36–2.54)	< .001	–	–
6–8 members	1.36 (1.09–1.69)	0.005	1.36 (1.10–1.69)	0.005	–	–
< 5 members	1.00		1.00		–	–
Household dietary diversity score	1.79 (1.15–2.79)	0.010	1.98 (1.26–3.11)	0.003	–	–
Poor	1.16 (0.88–1.54)	0.298	1.21 (0.91–1.61)	0.181	–	–
Moderately acceptable	1.00		1.00		–	–
Acceptable						
Food security status						
Severely food insecure	–	–	0.73 (0.53–1.02)	0.064	–	–
Moderately food	–	–	0.65 (0.46–0.92)	0.015	–	–
insecure	–	–	0.97 (0.76–1.24)	0.789	–	–
Mild food insecure	–	–	1.00		–	–
Food secure						
Age						
5.0–6.0 yr old	–	–	–	–	0.50 (0.29–0.88)	0.015
6.01–7.0 yr old	–	–	–	–	0.33 (0.18–0.61)	< .001
7.01–8.0 yr old	–	–	–	–	0.70 (0.44–1.12)	0.135
8.01–9.0 yr old	–	–	–	–	0.51 (0.30–0.87)	0.014
9.01–10.03 yr old	–	–	–	–	1.00	

marginalization issues contribute to unsettled poverty issues among the Philippines' agricultural sector (PSA 2016).

Poor water, sanitation, and hygiene (WASH) are associated with undernutrition because of parasitic infections and diarrhea. Evidence suggested that there is a close interaction between parasitic infections and undernutrition. It shares several common risk factors: lack of access to clean water, improved sanitation, and adequate hygiene. Although the toilet facilities of farming families in this present study were already exclusive in their respective households, the majority relied on dug and tube well without using any technique to make their drinking water safe (PSA 2012b). The connection of poor WASH and undernutrition also has socio-economic mechanisms (Utzinger *et al.* 2011; UNSD 2020). The drinking water supply was correlated with underweight and stunting among school children (Wamani *et al.* 2004; Nolla 2014). Meanwhile, improved drinking water sources and toilet facilities were positively correlated with the nutritional status of school-aged children (Lawal and Lawal 2010; Fink *et al.* 2011). In addition, cross-sectional studies done in Peru and Ethiopia showed that better sanitation is essential for the positive linear growth of school children (Spears *et al.* 2013; Fenn *et al.* 2012).

Also, it has been observed that the use of solid fuel has been suggested to increase the likelihood of stunting and other undernutrition indices since it results in indoor air pollution. Indoor air pollution promotes childhood diseases linked to child undernourishment (Tielsch *et al.* 2009; Mishra and Retherford 2007; Ruel *et al.* 2010). Meanwhile, children in Bangladesh households that used highly polluted cooking fuels were more likely to suffer from stunted growths than in households where clean cooking fuels are used (Hong *et al.* 2006). In this study, most of the farming households were using wood and charcoal as fuel for cooking. Prolonged exposure to a polluted environment due to unsafe WASH conditions can cause diarrhea or asymptomatic infections leading to loss of nutrients, malabsorption, and compromised digestion,

and eventually resulted in undernutrition (Jardim-Botelho *et al*. 2008).

Prevalence of Undernutrition among School-aged Children, Poor Household Dietary Diversity, and Food Security

Findings indicated that the prevalence of stunting among school-aged children among farming households is considered high in public health significance. In contrast, wasting and underweight among school children belonging to farming households were considered as high and medium public health significance, respectively. Most farming households explain a higher prevalence of undernutrition among schoolchildren with the poorest and poor wealth indices. Underweight and wasting among schoolchildren were most prominent in Southeast Asia and African regions, where agriculture is the primary source of income. Chronic poverty remains a significant predictor of undernutrition among school children – defining food access and improved sanitation (Best *et al.* 2010). In the Philippines and other developing ASEAN nations, all forms of undernutrition among schoolchildren were observed among the poorest households (FNRI 2016a; Rachmi *et al.* 2018). There is a close relationship between food insecurity and poverty and food insecurity and undernutrition because wealth enables the households to be able to absorb and recover from loss rapidly due to social safety nets and programs (Epule *et al.* 2012).

The food security status of farming households was comparable to the national estimates of secure food households in the Philippines; severe food insecurity was higher in agriculture-related homes than the national estimates (FNRI 2016d). Like the results of this study, findings in South Africa suggested that agricultural families were more likely to have inadequate foods available for the household than their non-farming counterparts (Burger *et al.* 2009; WFP 2012).

The exacerbating issues of food insecurity among farming households can be primarily explained by exposure to extreme natural calamities, declining soil fertility, dysfunctional input and output markets, low adoption of improved technologies, and poor access to different extension services provided by the government. Hence, it affects their household income and eventually their capacity to have sufficient access to food for all the households, leading to higher levels of food insecurity among agriculture and related households (FAO 2013; Below *et al.* 2010).

In relation to food security, household dietary diversity can be also used to predict the adequacy of nutrient intake at the household level (Ruel 2002). Findings of this study suggested that only a small proportion of agriculture and related households had an acceptable diet diversity, while the majority had a borderline acceptable and poor household diet diversity. The prevalence of poor household dietary diversity remains to be higher among agriculture and related households compared to the national estimates (FNRI 2016c).

Like food insecurity, dietary diversity score has the same determinants – which include the wealth index of the household, parental occupation, and other socio-economic status indicators (Berry *et al.* 2015). It was suggested that the wealth or economic status of a household is directly proportional to dietary diversity; as the wealth category of a household increases, household diet becomes more diverse (FNRI 2016a). Related studies suggested that more diversified agricultural food systems are highly associated with improved dietary quality; however, diversification among small-scale farmers is very scarce (Berry *et al.* 2015; Herforth 2015). The improvement in the quality of the diet shall also include access to markets for the trading of crops, modernization of agricultural techniques, and commercialization and market integration (Koppmair *et al.* 2016).

Factors Affecting the Nutritional Status of School Children

Household wealth index. Household wealth index was a significant factor associated with underweight and stunting among school-aged children belonging to farming households. The poorest quintiles consistently recorded the highest undernutrition rates among school children (FNRI 2016a). In this present study, households relying on farming increases the likelihood of having an underweight and stunted child. Evidence suggested that households belonging to the agricultural sector were the most vulnerable group that tends to have a malnourished child. They were primarily driven by socio-economic capacity since most of them belong to the poorest quintiles who usually have few assets or access to insurance or credit agents (Mahendra 2012; ADB-IFPRI 2009). Economic category affects the purchasing power of the households to acquire different essential supplies, including food. In the Philippines, this present study demonstrated a higher risk of underweight and stunted school children among farming households with the poorest wealth index.

The highest prevalence of stunting among school children was found among the poorest and poor quintiles. Chronic poverty resulted in a higher prevalence of stunting among growing children from preschool years until school age. The economic standing of a household significantly determines the power to obtain access to nutritious and safe food. It can also cause inaccessibility to essential health services and poor feeding practices, translating to impaired linear

growth among school children (Mesfin *et al.* 2015).

In India and the Philippines, school-aged children belonging to households below the poverty threshold category recorded a higher prevalence of stunting and being underweight and wasting (Katoch and Sharma 2016; FNRI 2016b). In a study conducted by Bhagowalia (2012), households belonging to the agricultural sector tend to have stunted children compared to their non-agricultural counterparts. However, at a higher level of income, lower cases of stunting have been found (Katoch and Sharma 2016; Arimond *et al.* 2011). Thus, the household wealth index is the most critical factor affecting school children's weight-for-age status in farming households (Capanzana *et al.* 2018).

Household size. The interplay of different environmental factors dramatically affects the nutritional status of school children. For example, the number of family members is related to adverse circumstances in the household. Available food for larger family members was frequently lower than the available food for smaller families; thus, food *per capita* decreases as the number of family members increases (Ajao *et al.* 2010). In this present study, it was observed that a higher proportion of stunted and underweight school children belonged to agriculture and related households with bigger household sizes.

Bigger household size has an unfavorable impact on calorie availability between family members. The effect was more significant in rural households compared to urban dwellers. It has an undesirable impact increasing at a deteriorating rate. This relationship reveals the capability of bigger households to start alleviating the adverse effects of an additional household member through exploiting economies of scale in consumption (Garrett and Ruel 2000). Based on different studies, school children living in households with 6–8 members tend to be more undernourished than households with < 6 members. In addition, a bigger household size contributes to lower levels of childcare and dietary intake and scarcity of resources (Herrador *et al.* 2014; Novella 2013; Mekonnen *et al.* 2013).

This study also suggested that household size was more significant in households in rural areas than their urban counterparts. The number of family members is related to the occurrence of adverse circumstances in the home. A higher percentage of underweight and stunted school children belonged to farming households with bigger household sizes. Available food for larger households was frequently lower than for smaller families; thus, food *per capita* decreases as family members increase (Ajao *et al.* 2010). Bigger household size has an unfavorable impact on calorie availability between family members. This relationship reveals the capability of bigger homes to start alleviating the adverse effects of an additional household member through exploiting economies of scale in consumption (Garrett and Ruel 2000). Recent studies showed that school-aged children with siblings pose higher incidences of stunting (Mondal and Sen 2009; Yu and Chen 2020). This mechanism can be attributed to resource scarcity due to larger family size, leading to the lower allocation of calories particularly to younger children (Mekonnen *et al.* 2013).

Household food security. Household food security is a prerequisite for a well-nourished child. The household food security status greatly determines the diet diversity of the child. Studies suggested that improved dietary diversity was significantly related to optimal nutrition of school-aged children (Nguyen *et al.* 2013; Harris-Fry *et al.* 2015). Meanwhile, studies from developing countries suggest that food insecurity harms the nutritional status of children (Ali *et al.* 2013; Lawal and Lawal 2010). However, this present study suggested severe food insecurity was a protective factor against being underweight among school children.

This study suggested that severe food insecurity was protective against underweight and stunting among school-aged children from farming households. Concerning the result of this study, several studies concluded that the association between undernutrition and food security was also reversed. The survey of Gundersen *et al.* (2009) demonstrated that higher levels of individual stressors among children increased weight, resulting in a higher weight-for-height index. Children in food-insecure households usually consumed cheaper kinds of foods which were generally high in calories but insufficient with micronutrients (Kuku *et al.* 2011).

Moreover, school children in food-insecure households were likely to have more inferior nutritional status than secure food households (Nguyen *et al.* 2013; Matheson *et al.* 2002). A possible mechanism indicates that diets of children belonging to lower wealth quintiles tend to lack essential nutrients and were mainly composed of rice (Angeles-Agdeppa *et al.* 2019). It also clearly implies the association of food supplies available in the households (Harris-Fry *et al.* 2018).

Household diet diversity. Concerning the wealth index, the farming household's poor and acceptable borderline diet diversity was significantly associated with stunting. Children exposed to lower dietary variety tend to be shorter as a chronic consequence of inadequate intake. Therefore, undernutrition could be reduced by improving the diet diversity available for consumption (Shetty 2013). Higher diversity scores were linked to improved height of school children. Meanwhile, severe, and moderate stunting among school children had lower mean scores

than their counterparts (Hackett *et al.* 2009). The variances in dietary diversity scores among low and high socioeconomic status were mainly due to variations in the intake of different food groups, primarily on meat and legumes (Hatløy *et al.* 2000).

Furthermore, it was found that low diet diversity was significantly linked with undernutrition among children (Motbainor *et al.* 2015). On the other hand, it was found that high dietary diversity scores reduced the odds of stunting among school-aged children in all age groups (Rah *et al.* 2010). In Nigeria, it was suggested that the number of meals provided daily for the child was linked to the present nutritional status of the child. Moreover, giving snacks to children was also positively related to improved weight-for-age and height-for-age status (Lawal and Lawal 2010). However, rice production and consumption in Ethiopia were protective against underweight and stunting among school children in farming households because it was used as cash crops that can augment household needs (Mekonnen *et al.* 2013).

It was also observed that a lower dietary diversity score was found among the poor and poorest wealth quintiles, wherein poverty was linked with a high intake of calories but inadequate micronutrients. The decrease in diet quality could lead to reduced body weight (Drewnowski and Specter 2004). It can be suggested that these issues can be improved by investing in diversification of crops, improving farm-to-market roads, and enhancing the small livestock production and food fortification (IFPRI 2014; Herforth *et al.* 2012; de Smet and Vossen 2016). Policymakers can support these initiatives to mitigate the adverse effect of scarcities among vulnerable households particularly farming households. It is evident in Brazil and Cambodia that sustained political will enable the integration of these programs into national policies that aim to mitigate hunger and undernutrition (Hotz *et al.* 2013; McLachlan and Landman 2013).

Age. Meanwhile, only age was associated with wasting among school-aged children, particularly among the older ones belonging to farming households. The same result was observed in the study conducted by Capanzana *et al.* (2018), wherein older children tend to be wasted than their counterparts. Increasing age requires higher nutrients to support the continuous growth before adolescence; therefore, school children who have insufficient food intake suffered from a reduction in body weight. Moreover, older children are already transitioning to puberty, where numerous inimitable challenges occurred, including higher body requirements, making them more susceptible to wasting (Akseer *et al.* 2017).

Meanwhile, the possible mechanism behind this observation can be explained that older and male children tend to be more undernourished (Fernandez and Abocejo 2014; Mekonnen *et al.* 2013; Capanzana *et al.* 2018). This can result from increased susceptibility of these children to child labor among agricultural communities (Kane 2009; ILO 2006). Thus, it entails higher energy requirements for these children (Torlesse *et al.* 2016) and considering the insufficiency of dietary intake among school children in the Philippines (Angeles-Agdeppa, *et al.* 2019).

Limitation of the Study

Even though secondary datasets provide important and cost-effective methods to study different determinants of undernutrition, the relationship between variables in the general population cannot be examined entirely because the data were collected from a study with a different objective. Moreover, a cross-sectional study design cannot establish causality; hence, it can only conclude if other explanatory variables or determinants were associated with nutritional outcomes. Lastly, the HFIAS used to measure the food security status is at risk of recall bias. Respondents may not remember and report their past experiences correctly and might provide subjective observations regarding the past experiences that can affect the study's validity (FNRI 2016a).

CONCLUSIONS

The present study revealed that undernutrition among school-aged children of farming households is of significant concern. Household wealth index tends to be an essential factor associated with underweight and stunting, while age appeared to be the only important factor in the final model associated with wasting. Poor dietary diversity score was also an essential confounding factor between socioeconomic status with underweight and stunting but not wasting. Therefore, it is recommended that government policies and programs for households with school-aged children suffering from undernutrition include livelihood, food production, better access to health services, and active involvement in the existing program provided by the government. Home-based food production should be strengthened to improve diet diversity and assistance to household head of farming household, including livelihood programs, is recommended to augment the scarcity of resources. Also, the government must evaluate the effectiveness of different health and nutrition programs implemented for this sector to explore the gaps that the existing programs missed to address. Future research must explore other proximal determinants of food insecurity and malnutrition – such as intrahousehold resource allocation, gender intrafamilial distribution, caregivers' coping mechanisms in response to food insecurity, and maternal behaviors.

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