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Influences of wealth index, family size, food security, and diet diversity status in the growth of Filipino school-age children in farming households

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Abstract

Undernutrition among school-age children remains to be highly prevalent in developing countries. The adverse impact of undernourishment among school-age children could significantly affect their cognitive development, school performance, and future productivity. Despite the government's efforts in poverty and hunger reduction, the Philippines continuously sustains a high prevalence of undernutrition among school-age children. This study aims to determine the influences of different factors on the weight, height, and body mass index of school-age children in farming households. This study utilized data from the 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups of the Food and Nutrition Research Institute. This study includes 1689 school-age children from farming households who satisfied the inclusion and exclusion criteria. The findings of this study suggested that household wealth index, household size, and food security status affected the weight of school-age children in farming households. It was also observed that household wealth index, size, food security status, and dietary diversity status significantly affect the height of school-age children in farming households. Lastly, the wealth index, the age of children, and the number of 0-10 years old children in farming households significantly affect their body mass index. The findings of this study provide empirical evidence that the most important underlying causes of undernutrition among school-age children belonging to farming households could guide policymakers and program planners to craft interventions that target this vulnerable group.

Keywords— farming households; growth; school-age children; food security; diet diversity

1 Introduction

Good health and proper nutrition were already recognized to contribute to school-age children's growth, development, and academic performance [1]. Despite advocacy for health and nutrition services among school-age children, there still needs to be more evidence regarding the nutritional status of this group in developing countries. Most of the evidence was focused on the malnutrition issues of young children under five years of age. This age group was often omitted from health and nutrition surveys or surveillance, and their nutritional status was poorly documented [2]. Malnutrition among school-age children remains to be highly prevalent in developing countries. The paucity of information hinders the development of relevant nutrition programs for school-age children [3].

Malnutrition among this age group is becoming a significant public health problem in underdeveloped and developing countries [4]. Globally, more than 200 million schoolchildren suffer from malnutrition, particularly stunting. The number is expected to increase by five folds if no intervention is made [5, 6]. Rural areas of developing countries are generally prioritized regarding nutrition intervention because undernutrition is more widespread than in urban areas [7]. In addition, school-age children are dramatically affected by micronutrient deficiency and parasitic infections that can harm the nutritional status of school children and will eventually impact their cognitive development and school performance [8, 9].

Despite the government's efforts in poverty and hunger reduction, the Philippines continuously sustains a high prevalence of undernutrition among school-age children [10]. Based on the 2015 National Nutrition Survey (NNS) conducted by the Food and Nutrition Research Institute (FNRI), among school children belonging to 5 to 10 years old, underweight (31.2%), stunting (31.1%) and wasting (8.4%) were still considered as a significant public health problem. There was an observed increment in the prevalence of underweight and stunting of 2.1% and 1.3%, respectively, compared to 2013 national estimates. Meanwhile, the prevalence of wasting remains unchanged from 8.6% (2013) to 8.4% (2015) [11]. Undernutrition during the school-age years may compromise the health and survival of future generations. In addition, undernourished children have a higher risk of future impairment [4]. During adolescence and their reproductive years, they are in a disadvantaged position, nutritionally and educationally [4].

Agriculture workers are among the most vulnerable groups because they depend on different climatic factors affecting their produce and harvest [12]. In the Philippines, agriculture workers, including farmers, fishermen, and foresters, recorded the highest incidence of poverty in 2015 at 34.3%, 34.0%, and 31.4%, respectively [13]. Meanwhile, undernutrition was problematic among school children in rural and urban communities, even during non-crisis situations in low-income countries [14, 15]. Evidence also suggested that larger households in the agricultural sector were the most vulnerable group. The condition worsens when households belong to the poorest quintiles. They tend to have few assets or access to insurance or credit agents, protecting them against shock from poor harvests due to some climatic problems [16, 17]. In a study by Bhagowalia [18], households in the agricultural sector tend to have marginally higher stunting and wasting compared to their non-agricultural counterparts.

Limited research has explored the determinants of height and weight among school-age children in farming households in the Philippines. Threats of undernourishment should be taken aggressively to prevent different consequences related to their growth and development and, eventually, future productivity. Therefore, investigating the determinants of physical growth among school-age children remains vital to designing an effective intervention strategy to alleviate this public health issue. Furthermore, the findings of this study can be used as a basis for planning and designing sustainable nutrition-specific and sensitive interventions. Thus, this paper intends to identify factors affecting the height, weight, and body mass index of school-age children in farming households.

2 Methodology

2.1 Study Design

A cross-sectional study design was utilized to determine the influences of different factors on the height, weight, and body mass index of school-age children in farming households in the Philippines. This design was used to examine different exposures and outcome variables simultaneously. Moreover, it allowed the researcher to measure the prevalence of all variables under investigation and compare one with another at the same time without incurring additional costs [19].

The study utilized the data from the Public Use File of the Food and Nutrition Research In-

stitute (FNRI) from the 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups. This national survey was conducted from July to November 2015 across 17 regions and 80 provinces. The survey is population-based and characterizes the Filipino population's nutritional status, dietary patterns, food security, and socio-ecological conditions. Data on the socio-demographic profile and growth indicators of school children belonging to farming households were assessed simultaneously.

2.2 Sampling

In this study, only school children aged 5.0 to 10.0 years old that belonged to farming households were included. Among the 43,310 households participating in the survey, only 12,326 households were identified as farming households based on the set criteria of FNRI using the Philippine Standard Occupational Classification. Only households with complete dietary and food security assessments were included in the data analysis. Hence, after excluding the respondents with incomplete data, 1,689 school-age children from 1,196 farming households from the four replicates were included in the survey [11, 13].

2.3 Data Collection

Data collectors were trained on the procedures of obtaining proper anthropometric measurements procedure and proper conduct of face-to-face interviews [11]. The following are the components of the survey used in this study:

1. Anthropometric assessment were done to measure the current weight and height of school-age children in farming households. A digital weighing scale was used to measure the weight of school children. Meanwhile, the standing height of school children was measured using a stadiometer. Lastly, the body mass index (BMI) was calculated using the formula 1:

$$BMI = \frac{Weight(kg)}{Height(m)^2} \tag{1}$$

2. Household Dietary Diversity (HDD) Guide was used to measure household dietary diversity. It was composed of 12 food groups to evaluate the household dietary diversity. The twelve 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 high. Households that consumed 5 groups per week are considered to have a poor diet diversity; meanwhile, 6-8 food groups in a week are considered to have borderline food consumption. Households with 9 groups are considered to have an acceptable diet diversity.
3. Household Food Insecurity Access Scale (HFIAS) was used to measure the food security status of the households based on their experiences. The HFIAS included nine (9) questions with a 30-day reference period, probing for the frequency and severity of conditions experienced by the household.
4. Socio-demographic and economic data were also collected. Data on age, parental educational attainment, and occupation were taken. Characteristics of household members and wealth index were collected for the socio-economic status.

2.4 Data Processing

Data was examined during coding, encoding, and editing to ensure that the data were complete, consistent, and suitable for the data analysis. Using a coding manual allowed for more straightforward checking and validation of information. The requested data was recorded using Microsoft

Excel and edited using STATA15 v15 to ensure accuracy before proceeding with data analysis. Data cleaning and validating were done manually by checking printed copies of encoded measurements against the recorded values.

2.5 Statistical Analyses

For this study, data were processed using the survey design function of STATA v15. For qualitative variables, frequencies and proportions were reported to describe the distribution of respondents according to categories, particularly the participants' demographic characteristics, household food security, and household dietary diversity status.

Multiple linear regression with adjusted effects was used to determine the effect of significant explanatory variables on the weight, height, and body mass index of school-age children in farming households. Multiple linear regression was also used to model the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data. In this study, the explanatory variable includes the demographic characteristics, food security status, household dietary diversity, and WASH practices of farming households with school-age children. Meanwhile, the independent variable was indicators of the physical growth of school-age children in farming households, including their weight, height, and body mass index. An α =.05 was used to determine the factors affecting the school-age children's height, weight, and body mass index.

3 Results

3.1 Demographic Profile

Table 1 presents the demographic profile, household food security, and dietary diversity status of farming households in the Philippines with school-age children. The proportion of school-age children tends to be almost the same when aggregated according to sex at 51.6% and 48.4% for boys and girls, respectively. Regarding the wealth index, three-fourths (75.6%) belonged to the poor and poorest households, and only a few (11.7%) were included in the affluent and wealthiest households. The majority of the heads and caregivers of the households (64.2% and 54.2%, respectively) had graduated from primary education. Therefore, relative to household heads' wealth index and educational attainment, most farming households with school-age children had a bigger family size.

Less than 30% of the farming households were food secure, while most of the households were experiencing different severity of food insecurity. More than a third (39.6%) of the households were experiencing mild food insecurity, and some (13.6%) were experiencing moderate food insecurity. Consequently, almost a fifth of the farming households experienced severe food insecurity during the study. In connection with the household food security status, the majority (73.0%) of the households had borderline acceptability of household dietary diversity.

3.2 Factors Affecting Weight and Height of School Children

Weight

Multiple linear regression estimated the effects of demographic, socioeconomic status, living conditions, water, sanitation, and hygiene practices while simultaneously adjusting for all other variables. With other variables held constant, it was observed that household wealth index, household size, and food security status significantly affect the weight of school-age children in farming households.

The full model shows a negative effect of household wealth index, household size group, and food security status on the weight of school-age children in farming households. In terms of the household wealth index as a predictor of weight, its negative association with weight declined as the wealth index of the household improved. Specifically, it was found that there was an almost 5 kg unit decline in the weight of school children when they belonged to the poorest farming households

(p<.001). Meanwhile, a negative association between the weight of school-age children belonging to farming was also observed among poor (p<.001), middle (p<.001), and rich (p<.001) household wealth index (Table 2).

Relative to the household wealth index, household sizes of >9 members and 6-8 members also had a negative relationship with the weight of school-age children belonging to farming households (p<.001; p<.001, respectively). On the other hand, there was a small but positive association between severe food insecurity and the weight of school-age children in farming households (p<.054).

Table 1. Demographic profile, food security status, and diet diversity of the farming households in the Philippines

Demographic characteristics of the respondents	**n=1,689**	**%**
Sex		
Boy	871	51.6
Girl	818	48.4
Wealth Index		
Poor and poorest households	1277	75.6
Middle-income households	215	12.7
Rich and richest households	197	11.7
Educational attainment of household heads		
Graduate or at least achieved Primary education	1085	64.2
Graduate or at least achieved Secondary education	502	29.7
Undergraduate in Tertiary education	45	2.7
Graduate of Tertiary Education	57	3.4
Educational attainment of caregivers		
Graduate or at least achieved Primary education	915	54.2
Graduate or at least achieved Secondary education	599	35.5
Undergraduate of Tertiary education	77	4.6
Graduate of Tertiary Education	98	5.8
Household Size		
<5 members	229	13.6
5-9 members	744	44.1
>9 members	716	42.4
Food security status		
Food secure	468	27.7
Mild food insecurity	669	39.6
Moderate food insecurity	230	13.6
Severe food insecurity	322	19.1
Household Dietary Diversity		
Acceptable	319	19
Borderline	1233	73
Poor	137	8.1
Mean age of school children	7.59 ± 1.4 years old	

Height

In terms of the linear growth of school-age children in farming households, the regression model suggested that household wealth index, household size, food security status, and household

Table 2. Factors affecting the weight of school children belonging to agriculture and related households: Philippines, 2015

Factors	Weight	
	Adjusted Effects (95% CI)	p-value
Household Wealth Index		
Poorest	-4.59 (-5.78 – -3.40)	<.001
Poor	-3.87 (-5.07 – -2.67)	<.001
Middle	-3.16 (-4.41 – -1.91)	<.001
Rich	-1.94 (-3.21 – -0.68)	0.003
Richest	1.00	
Household Size Group		
>9 members	-1.21 (-1.78 – -0.63)	<.001
5-9 members	-0.74 (-1.13 – -0.34)	<.001
<5 members	1.00	
Food Security Status		
Severely Food Insecure	0.59 (-0.01 – 1.19)	0.054
Moderately Food Insecure	0.22 (-0.39 – 0.84)	0.479
Mild Food Insecure	-0.30 (-0.76 – 0.16)	0.197
Food Secure	1.00	

dietary diversity score had negatively affected the growth potential of these children. Comparable to underweight, it was also observed that the household wealth index was negatively associated with the height of school-age children in farming households. In contrast, its negative effect on height declined as the wealth index of the household improved. Specifically, the height of school-age children belonging to farming households was observed among the poorest (p<.001), poor (p<.001), middle (p=.004), and rich (p= .014) household wealth index (Table 3).

Like underweight, household size of >9 members and 6-8 members was negatively associated with the height of school-age children (p<.001; p= .001). Furthermore, poor household dietary diversity score poses almost two units decrease in the height of school-age children belonging to farming households (p= .003).

BMI

The full regression model shows the negative effects of household wealth index, age of children, and the number of 0-10-year-old children in the household on the BMI of school-age children from farming households. Linear regression implied that there was a 1.50 units decline in the BMI of school-age children when they belonged to the poorest farming households (p<.001). In contrast, a decrease was also observed among poor households (p<.001), middle-wealth index households (p<.001), and rich-wealth index households (p<.001).

Meanwhile, the negative effect of age was also significant in the BMI of school-age children. Age 5.0-6.0 years old had a negative effect on the BMI of school-age children by -0.4 units (p<.001). Meanwhile, 6.01-7.0 years old (p=.007) and 7.01- 8.0 years old (p<.001) also had a negative effect on the BMI of school-age children belonging to farming households. Lastly, having at least 3-4 children in the household also decreased the BMI of school children by 0.4 units (p<.037). Details were shown in Table 4.

Table 3. Factors affecting the height of school children belonging to agriculture and related households: Philippines, 2015

Factors	Height	
	Adjusted Effects (95% CI)	p-value
Household Wealth Index		
Poorest	-6.26 (-8.30 – -4.23)	<.001
Poor	-4.64 (-6.66 – -2.62)	<.001
Middle	-3.06 (-5.15 – -0.97)	0.004
Rich	-2.64 (-4.74 – -0.54)	0.014
Richest	1.00	
Household Size Group		
>9 members	-2.32 (-3.27 – -1.37)	<.001
5-9 members	-1.16 (-1.81 – -0.50)	0.001
<5 members	1.00	
Food Security Status		
Severely Food Insecure	0.98 (-0.01 – 1.97)	0.053
Moderately Food Insecure	0.82 (-0.20 – 1.85)	0.114
Mild Food Insecure	-0.26 (-1.01 – 0.50)	0.501
Food Secure	1.00	
Dietary Diversity Score Status		
Poor	-2.03 (-3.39 – -0.68)	0.003
Moderately acceptable	-0.22 (-1.04 – 0.61)	0.604
Acceptable	1.00	

4 Discussion

The majority of the undernourished population dwells in rural areas of South East Asia, South Asia, and Africa, where agriculture tends to be the primary source of livelihood who are primarily smallholder farmers [16, 17]. Meanwhile, endemic undernutrition among school-age children is still widespread in rural and urban areas in non-crisis situations in low-income countries [16, 17].

Consistent with the results of this present study, Filipino households with the primary occupation of heads of the family, which involves elementary jobs, unemployed, which includes household head pensioners, and those involved in agriculture, forestry, and fisheries were the least food secure [20]. Due to widespread poverty and income inequality, undernutrition remains a significant public health problem in the Philippines, particularly among the population living in extreme poverty and the lowest income groups, including farming households [21]. It was observed that young children in households headed by fisherfolks and farmers had a higher prevalence of malnutrition than the overall prevalence among young children, except for being overweight [10]. Relative to the result of this study, based on the reports of the Philippines Statistics Authority, farmers, fishermen, and children that belong to these families have an income below the official poverty threshold which consistently recorded the highest incidence of poverty [22]. Aside from low income among farming households, parental educational attainment was also considered low since most of the household's heads and caregivers had attained or completed elementary education. It shows that the short-term needs for income among farming households across generations have become a vicious cycle of constantly neglecting education to augment the meager income of the households [23].

Despite the evidence suggesting the role of agriculture in improving children's nutritional status, undernutrition remains a significant problem in South East Asia, including the Philippines. Hence,

Table 4. Factors affecting the Body Mass Index of school-aged children belonging to farming households in the Philippines, 2015

Factors	Body Mass Index	
	Adjusted Effects (95% CI)	p-value
Household Wealth Index		
Poorest	-1.50 (-2.01 – -0.99)	<.001
Poor	-1.47 (-1.99 – -0.95)	<.001
Middle	-1.41 (-1.96 – -0.86)	<.001
Rich	-0.69 (-1.26 – -0.12)	0.017
Richest	1.00	
Age		
5.0-6.0 years old	-0.44 (-0.71 – -0.17)	0.001
6.01-7.0 years old	-0.36 (-0.63 – -0.10)	0.007
7.01-8.0 years old	-0.53 (-0.78 – -0.28)	<.001
8.01-9.0 years old	-0.08 (-0.34 – 0.18)	0.556
9.01-10.03 years old	1.00	
Number of 0-10 years old children in the household		
>5 children	-0.15 (-0.51 – 0.21)	0.415
3-4 children	-0.39 (-0.76 – -0.02)	0.037
1-2 children	1.00	

empirical evidence of the root causes of undernutrition should be established to develop a holistic approach that can enhance the nutrition situation in the region through a combination of different approaches that will benefit the most vulnerable groups [24, 25].

In this present study, the regression model suggested that the household wealth index was the most critical determinant that affected the weight of school-age children in farming households. It was found that the effect of the household wealth index decreases the weight of school children by 4.6 units when they belong to the poorest quintile, 3.9 units (poor households); 3.2 units (middle wealth households); 1.9 units (rich households). The negative effects tend to improve as the wealth index of agriculture and related household index increases. A household's economic resources significantly affect the family's capacity to purchase food and other food supplies, which pertains to the food accessibility domain of food security. The household must acquire or buy foods available through their economic resources to achieve food accessibility. It was found that children who skipped or reduced meals because of insufficient finances were significantly more likely to have lower weight [26]. Numerous pathways link parental education and wealth index with child growth. For example, it can be explained that household with more wealth was more likely to acquire and provide nutritious food for the family members [27]. It was also observed that lower household income reported purchasing fewer vegetables and fruits, fiber-rich foods, and sugary foods than households with higher income [28]. A related study also observed that lower-income families are less likely to purchase recommended healthy foods, including fruits and vegetables. These families spend a more significant proportion of their budget on unhealthy food choices. Lower-income households purchase foods of lower nutritional quality compared to higher-income households. The lower nutritional quality of foods purchased could contribute to the lower diet quality observed among lower-income individuals [29].

Relative to the wealth index of the family, another factor that worsens weight among school-age children from farming households was the household size. Household wealth index and size significantly affect the households' ability to access adequate food for the family. The number of

family members is also related to the incidence of adverse circumstances. Available food for more significant family numbers was frequently lower than the available food for smaller families; thus, food per capita decreases as the number of family members increases [26]. It has been observed that family size directly affects food distribution within a family, wherein a higher number of family members implies a smaller allocation of food per person. The food distribution allocation can explain this phenomenon at the individual level of resources per person, usually lower in bigger families [30]. Hence, children from more prominent families usually had a lower weight than those with only one child [31].

Research findings consistently observed a relationship between lower wealth income status and household food insecurity. As time progresses, findings on the relationship between food insecurity and children's weight produce different results. Several research findings observed that food insecurity increased weight among children [18, 26, 32]. In this present study, it was observed that severe food insecurity poses a positive increase in the weight of school-age children. Although several mechanisms can explain these effects, it was observed that food-insecure households had lower consumption of fruits and vegetables and a higher proportion of carbohydrate sources. However, lower intake was found among protein and micronutrients compared with food-secure households [33]. Findings of related studies suggested that household food insecurity tends to be associated with overweight among children which can be explained by sociocultural factors [34, 35]. It can also be explained that mothers likely protect their children from the effects of food insufficiency in their homes as much as possible when the household experiences acute food shortages [36, 37]. Mothers are thought to sacrifice their food supply to ensure that children should remain food secure. This theory is supported by the evidence provided by the findings of this related study that only half of the food-insecure households had food-insecure children [36, 37].

Several studies conducted in developed and developing countries have shown a strong relationship between socioeconomic variables and the achieved height of children [38, 39, 40]. Children from poor households had worse linear growth outcomes than those from rich households. In the study of Sunny et al. [41], higher proportion of linear growth retardation was observed in families with lower wealth index scores.

Like the findings of other studies, the household wealth index of the farming households in this study also worsens the height of school-age children from farming households. The height of school-age children in farming households tends to falter when living among households classified under the poorest quintile. Comparable to underweight, the effect of a low wealth index on the height of school children improves as the wealth index increases [**schell_chapter_202**, 42]. Unlike underweight, stunting results from chronic exposure to inadequate intake of nutritious foods, which can be attributed to long-term exposures of children to different adverse environmental conditions and insufficiency, including poverty [43]. East Asia region is one of the areas with significant numbers of chronically poor people concentrated in remote and low-potential rural areas where agriculture remains the source of livelihood [44]. Rural areas must be better connected to markets and urban centers [44]. In addition, households where fisherfolks or farmers were the household head experienced the highest poverty incidence in the Philippines in 2018 and were found to have children with a higher prevalence of stunting and wasting than other households [22, 45].

Another factor that negatively affected the height of school children was household size. The highest decrease was among bigger households with >9 members and 6-8 members. Relative to being underweight, a possible mechanism between household size and its negative effect on height can be attributed to resource scarcity since increasing household size decreases the available nutrients for each member [46]. Evidence suggested a clear link between family size and stunting among children [47]. Children from bigger households may get lower nutrition appropriation and lack parental care and attention. Parents of large family sizes may also prioritize and spend more

money to fulfill other family needs and provide a smaller appropriation for health and nutrition needs [48].

Apart from household wealth index and household size, poor dietary diversity status negatively affects the height of school-age children. The highest mean dietary diversity score of 10.2 was found among the wealthiest households, followed by middle-income households (9.4), and the lowest score of 8.4 was found among the poorest households. Household income directly affects the dietary diversity of a household. Families that belong to low-income groups had a higher risk of becoming undernourished because they could not access a broader range of food groups and had lower diet quality [22]. Evidence suggests that the undernourished people in Africa and Asia dwell in small-scale subsistence farming areas. Diversifying the farmers' production is perceived as a strategy to enhance dietary diversity and quality in several countries, including Kenya, Indonesia, Malawi, and Ethiopia. Higher farm production diversity significantly contributes to dietary diversity.

Moreover, improving market access is a more effective strategy for improving nutrition outcomes [59]. In addition, the present study suggests that severe food insecurity was positively associated with the height of school children in agriculture and related households by 0.98 units. However, the possible mechanism for this positive association can be explained as linear growth develops over a period of time; thus, acute circumstances of food insecurity cannot determine the height of school children [49].

Relative to weight and height, body mass index tends to be negatively affected by the household wealth index. In this study, low wealth indices also negatively affected BMI, whereas more detrimental effects were observed among the poorest households. Improvement in the wealth index promotes the consumption of nutritious foods available for every family member, which could be due to the significant level of consumption of resources in the household [50]. In another related finding, children who skipped or reduced meals because of insufficient finances were significantly more likely to be wasted [11]. This study's findings also support the previous studies' claims that children with many siblings are more likely to suffer from lower body mass index [51]. In relation to this recent study, it was found that living in a farming household with 3-4 children can also negatively affect the body mass index of school-age children.

The BMI was also linked to individual family size attributed to economic development. This association has a negative epidemiological effect among children, wherein a family with only one child had a greater risk of having a higher BMI [52]. However, research in Israel suggested that parental involvement and the home environment significantly impact children's eating behaviors and physical activity, and fewer obesogenic factors were met in families with fewer children [53]. In this study, age also negatively affected school children's body mass index in farming households, unlike underweight and stunting. Older children (OR=0.93) and the occupation of the household heads, either fishing (OR=0.71) or farming (OR=0.77) were found to be associated with lower body mass index among school children. A related study found that boys had 77% higher odds of stunting [54]. The findings of different studies suggested that children from poor households tend to become lighter compared to the reference population, which can be attributed to the family's waning capacity to provide for and care for their children [36, 38]. Excess energy loss and inadequate food intake could lead to undernourishment among growing school children. Certainly, underweight school children had a higher level of physical activity than their overweight counterparts [55, 56].

4.1 Limitation of the study

A cross-sectional study design cannot establish causality; thus, it can only conclude if different explanatory variables or determinants were associated with the outcomes. Furthermore, the results of this study cannot be generalized among all farming households in the Philippines since the data used in this research does not account for the specific objective of this present study.

Research instruments used in the study, including the household dietary diversity questionnaire

and Household Food Insecurity Access Scale, were prone to recall bias. As a result, the respondents might need to catch some food items and actual experiences of food insecurity. Moreover, the answer or responses of the respondents might have been affected by social desirability bias. Respondents might recall or answer the survey based on their perceptions of how they will be adjudicated from the study [57].

Lastly, several explanatory variables were observed in the previous studies that were not controlled in the current study, such as government support, rural-urban differences, and income classification of the communities, past morbidities, and vaccination history [58].

5 Conclusion

The present study revealed that household wealth index, household size, and food security status affected the weight of school-age children in agriculture and related households. Meanwhile, a separate model observed that household wealth index, size, food security status, and dietary diversity status significantly affect children's height in agriculture and related households. Lastly, household wealth index, age of children, and the number of 0-10 years old children in the households significantly affect the body mass index of school-age children in farming households.

The findings of this study provide empirical evidence that the most important underlying causes of malnutrition among school-age children belonging to farming families were household wealth index and household dietary diversity. Hence, ways to make food systems and agriculture more nutrition-sensitive are highly relevant for future research and policy.

Ethical consideration

Recruited households were given written informed consent prior to participation. The conduct of the study was approved by the Ethics Committee of the FNRI with protocol number FIERC-2015-006.

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