Silver Hair and Healthy Growth:

Grandparents and the Health of Thai School-Age Children

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This study examines the relationship between household structure and socioeconomic factors with the nutritional status of vulnerable school-age children, and estimates the causal effect of elderly allowances received by grandparents on children's nutritional outcomes in grandparent-headed households. Using data from students aged 6-14 screened for the Equitable Education Fund's (EEF) conditional cash transfer program in 2022 and 2024, OLS regression results show that household structure is significantly associated with child nutrition status: extended and skipped-generation households show positive associations with HAZ and WAZ, while children in single-parent and divorced-parent households have significantly worse nutritional outcomes. Triple Difference (DDD) analysis reveals that grandmother allowances positively and significantly affect HAZ scores in children aged 6-7, while grandfather allowances significantly improve WHZ in the same age group only. These effects are not found in older children. Findings suggest an important role of grandparents' role as potential caregivers, and underscore the importance of integrating elderly welfare policies with child development programs, particularly through transfer mechanisms that account for grandparent caregiving roles, nutritional education for elderly caregivers, and early childhood interventions targeting vulnerable populations.

Keywords: child health, grandparenting, skipped-generation households, elderly allowance, human capital

1. Introduction

In recent years, Thailand has been experiencing profound demographic change. Specifically, in 2025 the country recorded fewer than 500,000 births for the second consecutive year, with a total fertility rate (TFR) of approximately 0.86, which is well below replacement rate. Simultaneously, the share of the population aged 60 and above rose from 6.8% in 1994 to 20.0% in 2024, making Thailand one of the fastest-ageing societies in Southeast Asia. Both pressures intensify the urgency of investing in the quality of existing human capital.

Based on Becker's (1964) concept of human capital, long-run economic productivity is rooted in the early-life accumulation of health, knowledge, and skills. Grossman (1972) developed an economic model, in which health is viewed as both a durable consumption good and a capital input generating future returns. Substantial evidence confirms that nutritional status in the first 1,000–3,000 days of life is associated with cognitive development, academic performance, and adult earnings (Hoddinott et al., 2013).

Despite Thailand's upper-middle-income status, child malnutrition remains a significant public health concern. UNICEF and Ministry of Public Health data indicate persistent stunting among children under five, while overweight and obesity in children have risen sharply; this phenomenon is known as a double burden of malnutrition in which undernutrition and overnutrition coexist in the same households and communities (Pongcharoen et al., 2024; Rojroongwasinkul et al., 2013).

A critical but under-studied dimension of child nutritional outcomes is household structure. As working-age adults migrate to urban labor markets, grandparents increasingly undertake primary caregiver roles in the context of either skipped-generation households, in which grandparents live with grandchildren without parents present, or extended households, in which multiple generations co-reside. Bertrand et al. (2000) argue that household resources do not automatically translate into child welfare; who controls and allocates those resources is decisive.

Nonetheless, existing studies in Thailand focus primarily on maternal education, household income, and access to healthcare, while there is little evidence on household structure and grandparent roles, particularly in economically vulnerable populations. This study addresses that gap with two main research questions. First, how are socioeconomic status and household structure associated with the health of school-age children? Second, how does grandparent co-residence or grandparent income, particularly the elderly allowance, affect children's nutritional outcomes?

Consequently, this study has two objectives. The first objective is to analyze associations between socioeconomic factors and household structure with the nutritional outcomes of economically vulnerable school-age children, measured by growth z-scores and malnutrition indicators. The second objective is to estimate the causal effect of grandparent-received elderly allowances on the nutritional status of children in grandparent-headed households.

The sample in this study covers students aged 6-14 enrolled in schools under the Office of the Basic Education Commission (OBEC), who have been screened for the EEF conditional cash transfer (CCT) program in academic years 2022 and 2024. This sample represents approximately 1.4 million students, or 20.98% of Thailand's population of age 6-14 years old.

2. Literature Review and Conceptual Framework

2.1 Measuring Child Nutritional Status

Child malnutrition is assessed using anthropometric z-scores calculated relative to a reference population. This study uses three standard indicators, namely Height-for-Age Z-score (HAZ), Weight-for-Age Z-score (WAZ), and Weight-for-Age Z-score (WAZ). While HAZ measures stunting as a marker of chronic undernutrition, WAZ identifies underweight status stemming from short-term deficits. Meanwhile, WHZ evaluates wasting and obesity by focusing on overall body proportion. The formula used to calculate Z-scores can be written as:

$$z - score_{ia} = \frac{(x_{ia} - m_a)}{sd(a)}$$

where x_{ia} is the child's anthropometric value, m_a is the median of the reference population, and $sd(a)$ is the standard deviation. Reference standards follow the Department of Health, Ministry of Public Health (2021) norms for children aged 6-19 years.

Table 1: Classification Criteria for Nutritional Status

Indicator	Criteria	Nutrition Status
HAZ	HAZ < −2	Stunting
	−2 ≤ HAZ < −1.5	Mild Stunting
	−1.5 ≤ HAZ ≤ 1.5	Normal
	1.5 < HAZ ≤ 2	Tall
	HAZ > 2	Very tall
WAZ	WAZ < −2	Underweight
	1.5 ≤ WAZ ≤ 1.5	Normal
	WAZ > 2	High weight-for-age
WHZ	WHZ < −2	Wasting
	−1.5 ≤ WHZ ≤ 1.5	Normal
	2 < WHZ ≤ 3	Overweight
	WHZ > 3	Obese

Source: Department of Health, Ministry of Public Health (2021).

2.2 Socioeconomic Factors and Child Health

The literature often associates maternal education, household wealth, and geography to child nutritional outcomes. Strauss (1990) found household income and food prices affect child nutrition, but maternal education, particularly secondary level and above, has a larger and more consistent positive effect. Sebsbie et al. (2022) and Waleewong & Yueayai (2022) confirm that low maternal education, household wealth inequality, and rural residence correlate with stunting

and wasting. Conversely, wealthier urban households face higher obesity risk due to high-energy diets and sedentary lifestyles, which is a pattern consistent with the nutrition transition.

For Thailand specifically, Kirdruang (2020) found household wealth and parental co-residence significantly affect early childhood health (ages 0-5). Chaiyuth et al. (2025) estimated that EEF conditional cash transfers significantly improved WAZ and WHZ, with the strongest effects among primary-school-age children and girls, and most pronounced in the three Southern provinces (Yala, Narathiwat, and Pattani), where the students in the region have the lowest baseline z-scores nationally.

2.3 Grandparenting and Child Health

A growing body of international literature examines grandparent involvement and child health outcomes, with mixed but generally positive findings in developing-country contexts. Pulgaron et al. (2016) reviewed studies across multiple countries and found grandparent involvement associated with higher child weight, with heterogeneous effects on eating behaviors depending on cultural context.

Sadruddin et al. (2019) conducted a systematic review finding positive effects on survival, height, and weight in Ethiopia, Gambia, and the United Kingdom, but higher BMI and developmental delays in Japan, Sweden, and the United States. Notably, children in skip-generation households tend to have worse educational outcomes than those in multigenerational households. Barschkett (2025) found grandparental care has positive short-term health effects that persist across generations into great-grandchildren; they argue that grandparents transmit nutritional and health knowledge inter-generationally.

With regard to cash transfers, Duflo (2003) studied South Africa's pension program and found pensions received by grandmothers significantly improved granddaughters' WHZ, with no significant effects on grandsons. Grandfather pensions had no significant effect on either sex; this finding supports the intrahousehold bargaining theory that women invest more in children.

Furthermore, Schrijner & Smits (2018) found in Sub-Saharan Africa that maternal grandmother co-residence raised HAZ, with effects stronger for grandmothers than grandfathers. Liu et al. (2021) found grandparent care positively and significantly affects child health in China, with the strongest effects for HAZ in children under 5 years, diminishing with age.

2.4 Conceptual Framework

This study adapts Strauss's (1990) child health production model, treating child nutritional status as an output determined by three input groups: (1) individual characteristics (age, sex); (2) household-level factors (income, parents' marital status, guardian's education, household composition, and assets); and (3) community-level factors (region). Following Bertrand et al. (2000) and Sun & Yang (2020), grandparents' roles are incorporated as both an *income channel*, in which grandparent earnings supplement household resources, and a *time channel*, in which grandparent presence increases childcare time and reduces resources diverted from child welfare.

This study tests three primary hypotheses: *first*, children from households with lower income, lower education levels, non-parental care, or rural locations exhibit a higher risk of undernutrition; *second*, extended and skipped-generation family structures correlate with superior nutritional status compared to nuclear or single-parent units; and *third*, the receipt of elderly allowances by grandparents positively affects children's nutritional outcomes.

3. Data and Methodology

3.1 Data

The dataset covers students in schools under OBEC aged 6-14 who underwent poverty screening in 2022 and 2024 in order to receive cash transfers from both OBEC and EEF. Data include three components: (1) household survey data (Form Nor Ror.01) recording household members, income, and asset endowments across eight dimensions; (2) poverty screening outcomes using a proxy means test (PMT), classifying households into non-poor, near-poor, poor, and extra-poor categories; and (3) individual height and weight records linked from OBEC's student information system.

The sample includes approximately 904,993 students aged 6-11 and 435,836 aged 12-14 in 2022, and 883,313 and 380,558 respectively in 2024. Average household per capita income in the sample was 2,293 THB/month, which below the 2024 national poverty line of 3,078 THB/month, and even below the first quintile of the national income distribution (3,556 THB/month). The extra-poor subsample had average per capita income of just 985 THB/month (approximately 38 THB/day).

3.2 Household Structure Classification

In this study, households are categorized into five distinct structures as follows:

1) *nuclear family* - a traditional two-generation household with both parents present;
2) *extended family* - multi-generational home where grandparents, parents, and children co-reside;
3) *single-parent family* - a household led by a individual parent raising their children;
4) *skipped-generation family* - a unique dynamic where grandparents and grandchildren live together in the absence of the parents; and
5) *others* - diverse kinship structures involving extended family members like aunts, uncles, and cousins.

3.3 Empirical Strategy

(1) OLS and Logit Models

To analyze associations between household structure and child nutrition, OLS regression is estimated for z-score outcomes (HAZ, WAZ, and WHZ) and logit models for binary malnutrition indicators (stunting, wasting, underweight, overweight, and obese). The baseline specification is:

$$Y_{it} = \beta_0 + \beta_1 Extend + \beta_2 SingleP + \beta_3 Skipgen + \beta_4 Other + \alpha X_{it} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the child health outcome (HAZ, WAZ, WHZ, or binary malnutrition indicators); household type dummies use nuclear family as reference; and $\boldsymbol{X}$ is a vector of control variables, including child age (months), gender, guardian education level and occupation, parental marital status, household per capita income, number of elderly and child members, presence of disabled or unemployed members, home ownership, poverty status (as measured by PMT score), and region (Central/Bangkok as reference). Logit models report average marginal effects (AME).

(2) Triple Difference (DDD) Estimator

To identify the causal effect of the elderly allowance on child nutrition, a Triple Difference (DDD) design exploits variation across three dimensions: (1) whether the grandparent receives the elderly allowance (Grandma/Grandpa); (2) whether the grandparent is the child's primary guardian (GPGuard); and (3) time period (Post = 2024 vs 2022). The estimating equation is:

$$\begin{aligned} Y_{it} = \alpha + \delta_1(Grandma_{it} \times GPGuard_{it} \times T_t) + \delta_2(Grandpa_{it} \times GPGuard_{it} \times T_t) \\ +\beta_1 T_t + \beta_2 Grandma_{it} + \beta_3 Grandpa_{it} + \beta_4 GPGuard_{it} \\ +\beta_5(Grandma_{it} \times T_t) + \beta_6(Grandpa_{it} \times T_t) \qquad (2) \end{aligned}$$

The DDD estimators δ_1 and δ_2 capture the differential change in child nutrition for children in grandparent-headed households whose grandmother or grandfather (respectively) receives the elderly allowance, relative to children not meeting all three conditions. Analysis is restricted to children aged 6–11, given stronger grandparent caregiving effects in this age group. Results are reported separately for sub-groups aged 6–7, 8–9, and 10–11 to identify age-specific windows of effect.

4. Descriptive Statistics

4.1 Nutritional Outcomes and Sample Characteristics

Table 2 summarizes nutritional outcomes and key sample characteristics. In 2022, HAZ scores are slightly negative (−0.37 for ages 6-11 and −0.30 for ages 12-14), indicating modest shortfalls below the national reference standard. WHZ values are near zero, suggesting approximately normal weight-for-height on average. Stunting prevalence is the highest malnutrition category at approximately 7.9% across both age groups, followed by overweight/obesity at 6-7%.

Comparing 2022 to 2024, stunting among 6-11year-olds declined slightly (7.94% to 6.97%), but wasting increased substantially (4.87% to 6.12%) and underweight rose (3.74% to 4.42%). All z-score indicators worsened slightly in 2024, potentially reflecting delayed economic hardship from cost-of-living increases. In terms of household structure, grandparents serve as primary guardians for 22-25% of the sample, with this share rising between 2022 and 2024 as parental guardianship declined from ~75% to ~72%.

Table 2: Nutritional Outcomes by Year and Age Group

Variable	2022		2024	
	Age 6–11	Age 12–14	Age 6–11	Age 12–14
Z-scores (Mean)				
HAZ	−0.37 (1.18)	−0.30 (1.17)	−0.35 (1.15)	−0.32 (1.16)
WAZ	−0.19 (1.44)	−0.17 (1.36)	−0.25 (1.45)	−0.22 (1.37)
WHZ	0.04 (1.60)	0.01 (1.49)	−0.09 (1.60)	−0.04 (1.49)
Malnutrition Prevalence (%)				
Stunting (HAZ < −2)	7.94%	7.86%	6.97%	7.90%
Wasting (WHZ < −2)	4.87%	3.57%	6.12%	3.76%
Underweight (WAZ < −2)	3.74%	4.03%	4.42%	4.82%
Overweight (WHZ > +2)	6.73%	6.13%	6.27%	5.91%
Obese (WHZ > +3)	6.52%	5.14%	6.12%	5.09%
N	**904,993**	**435,836**	**883,313**	**380,558**

Note: Standard deviations in parentheses.

Table 3: Sample Characteristics by Year and Age Group

Variable	2022		2024	
	Age 6–11	Age 12–14	Age 6–11	Age 12–14
Guardian Type (%)				
Grandparent(s)	22.42%	19.48%	25.11%	21.71%
Parent(s)	74.57%	76.55%	71.79%	74.21%
Other relatives	3.01%	3.97%	3.10%	4.08%
Household Structure (%)				
Extended family	32.12%	27.08%	34.64%	29.85%
Nuclear family	33.83%	35.22%	31.44%	32.19%
Single-parent	15.13%	18.39%	13.54%	17.27%
Skipped-generation	11.56%	11.53%	12.61%	12.57%
Guardian Education (%)				
Below primary	8.56%	9.18%	8.17%	7.90%
Primary	36.40%	40.14%	34.26%	35.90%
Lower secondary	24.57%	24.00%	24.47%	25.21%
Upper secondary/vocational	25.09%	22.59%	27.01%	25.93%
Undergraduate+	5.38%	4.09%	6.09%	5.06%
Guardian Occupation (%)				
Employee/trader/skilled	21.51%	20.96%	21.62%	21.57%

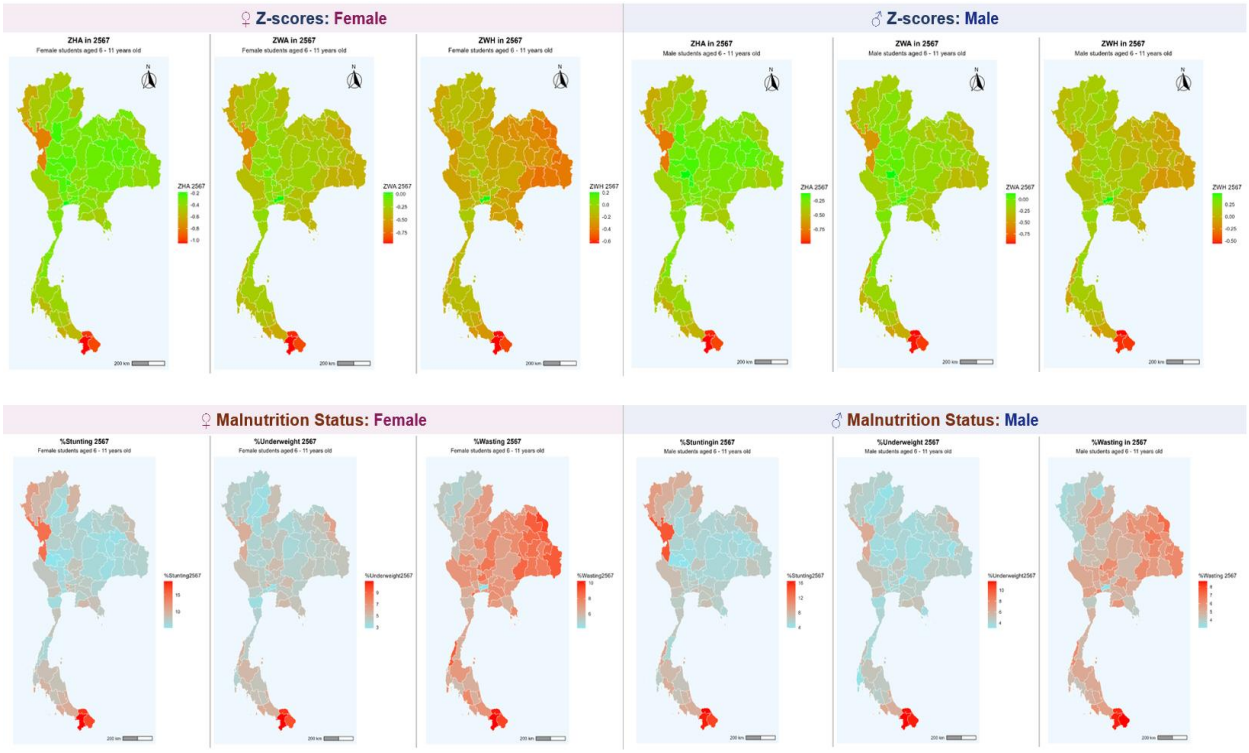
Day laborer	38.29%	36.95%	37.57%	36.79%
Agriculture	30.66%	34.56%	30.00%	33.69%
Unemployed	9.54%	7.53%	10.82%	7.96%
Parental Status (%)				
Together	60.44%	55.98%	57.87%	52.37%
Divorced	18.36%	21.29%	20.47%	24.16%
Separated	17.39%	16.93%	17.68%	17.43%
Parent deceased	3.81%	5.81%	3.98%	6.03%
Region (%)				
Bangkok & Central	16.15%	15.95%	14.48%	15.16%
North	23.34%	21.95%	22.85%	20.59%
East	5.81%	5.65%	5.49%	5.72%
Northeast	40.43%	43.51%	42.87%	46.05%
South	14.27%	12.94%	14.31%	12.47%
N	**904,993**	**435,836**	**883,313**	**380,558**

Note: Extended family = grandparents + parents + children co-residing. Skipped-generation = grandparents + grandchildren, without parents.

4.2. Geographic Distribution of Child Nutritional Status

Figures 1 and 2 map the spatial distribution of z-scores and malnutrition prevalence across Thailand's provinces in 2024, disaggregated by sex. Colour intensity indicates severity: red tones reflect negative z-scores (nutritional deficits); green tones reflect positive z-scores (above-reference nutrition).

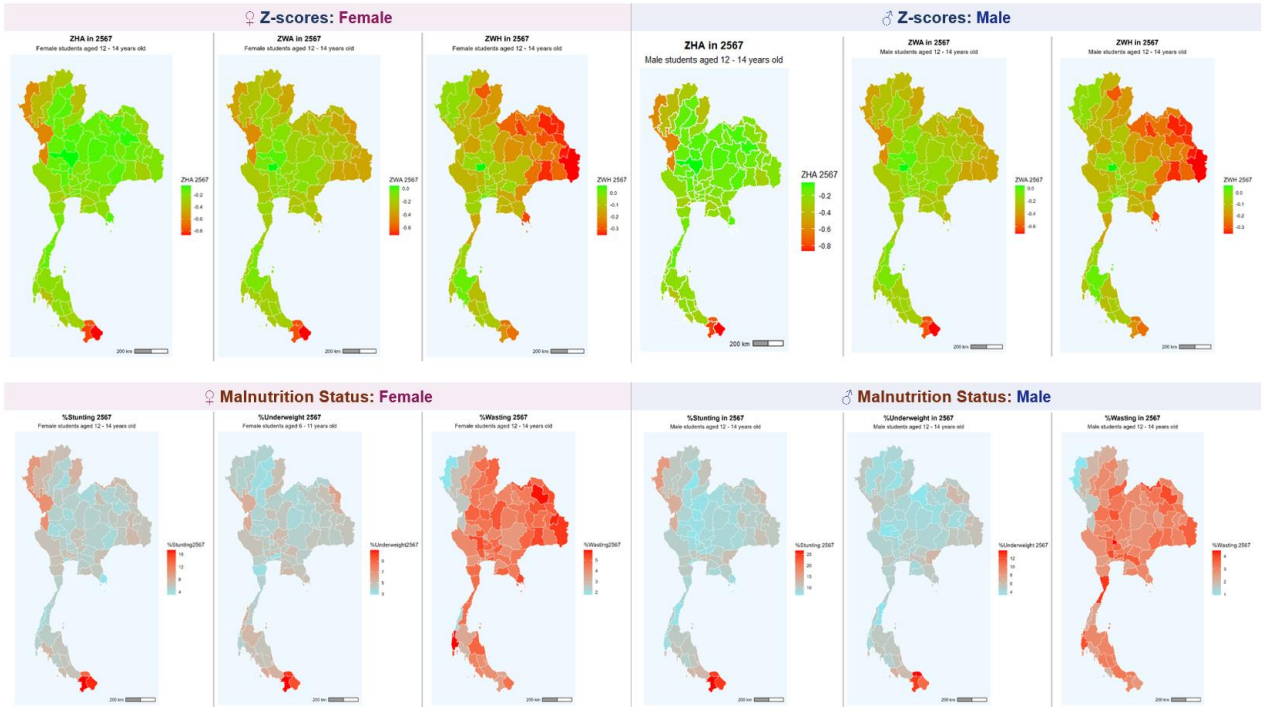
Figure 1: Provincial Z-scores and Malnutrition Rates in 2024 (Ages 6–11)



Top panels: HAZ (left), WAZ (centre), WHZ (right) by province for female (♀) and male (♂) students aged 6–11. Bottom panels: Stunting, Underweight, and Wasting prevalence rates by province. Source: Authors.

For ages 6–11, the most severe HAZ deficits are concentrated in Mae Hong Son and Tak (North/West) and the three Southern border provinces (Pattani, Yala, and Narathiwat) for both girls and boys. Nationally, WAZ scores are below zero across most provinces (orange-yellow tones), with the same deep-South provinces and Mae Hong Son showing the lowest values. WHZ patterns reveal that boys in Northeastern provinces (Bueng Kan, Nakhon Phanom, Mukdahan, Sakon Nakhon) have the lowest weight-for-height scores, indicating elevated wasting risk. Bangkok and surrounding Central provinces show positive WAZ and WHZ scores (green), reflecting the double burden dynamic: children from better-off urban households tend toward overweight rather than undernutrition.

Figure 2: Provincial Z-scores and Malnutrition Rates in2024 (Ages 12–14)



Top panels: HAZ, WAZ, WHZ by province for female (♀) and male (♂) students aged 12–14. Bottom panels: Stunting, Underweight, and Wasting prevalence rates by province. Source: Authors.

For ages 12–14, boys have markedly lower HAZ than girls across most provinces, particularly in the West and South-border provinces. This partly reflects that girls enter puberty and complete linear growth earlier. Wasting prevalence is strikingly high among girls aged 12–14 in Northeastern provinces, with WHZ values as low as −3 SD in Bueng Kan, Nakhon Phanom, Mukdahan, and Ubon Ratchathani. The three deep-South border provinces continue to display the most severe deficits across all indicators for both sexes. These spatial patterns underscore substantial regional inequality in nutritional outcomes.

5. Results

5.1. Baseline Model: Household Structure and Child Nutrition

(1) Ages 6–11: OLS Results

Table 4 reports OLS estimates for children aged 6–11 (N = 883,313). The reference group is a girl in a nuclear family whose guardian has no formal education, works as an employee or trader, lives with both parents, has no disabled household member, is classified as non-poor, and resides in Bangkok or the Central region.

The impact of household structure on child nutrition is surprising. Children in extended family have significantly higher z-scores across all three dimensions (HAZ: +0.078; WAZ: +0.082; WHZ: +0.046, all $p<0.001$) relative to nuclear family children. More strikingly, children in skipped-generation households, in which children live with grandparents without parents' presence, have even larger positive associations with HAZ (+0.121) and WAZ (+0.091). This finding challenges the assumption that parental absence is uniformly detrimental in this vulnerable population: grandparent caregiving appears to compensate substantially, at least on growth and weight-for-age outcomes. In contrast, single-parent children show significantly worse outcomes across all dimensions ($p<0.001$).

In terms of household composition, the number of elderly members is positively associated with HAZ and WAZ ($p<0.001$). This result is consistent with the time channel: more elderly members increase available caregiving time. Moreover, unemployed household members show similar positive associations, reinforcing the time channel interpretation. Conversely, each additional child in the household reduces all z-scores significantly, reflecting resource competition within the household.

Furthermore, parental marital status exerts independent effects beyond household structure. Particularly, divorced parents are associated with reductions in all z-scores, while separated parents show similar patterns. Regarding socioeconomic status, guardian's education has a monotonically positive gradient: children of undergraduate-educated guardians score higher in HAZ than children of uneducated guardians. Per capita household income is positively associated with all z-scores. The extra-poor classification yields the largest single effect in the model: −0.168 SD in HAZ, −0.178 SD in WAZ, and −0.109 SD in WHZ. This result emphasizes the depth of nutritional vulnerability at the economic margin. Finally, there is regional variation. Southern Thailand shows the most severe HAZ and WAZ deficits (−0.153 and −0.149 SD respectively). The Northeast has relatively higher HAZ but substantially lower WAZ and WHZ, suggesting regional dietary patterns that support height but not weight-for-height adequacy.

Table 4: OLS Regression - Household Structure and Z-scores (Ages 6–11)

Variable	HAZ	WAZ	WHZ
Household Structure (ref = Nuclear family)			
Extended family	0.078***	0.082***	0.046***
Single-parent	−0.015***	−0.027***	−0.027***
Skipped-generation	0.121***	0.091***	0.021**
Child Characteristics			
Age (months)	0.0036***	0.0072***	0.0104***
Male (=1)	0.045***	0.139***	0.310***
Guardian Education (ref = No education)			
Primary	0.048***	0.072***	0.056***
Lower secondary	0.060***	0.093***	0.077***
Upper secondary/vocational	0.120***	0.137***	0.085***
Undergraduate+	0.157***	0.157***	0.079***
Guardian Occupation (ref = Employee/trader)			
Day laborer	−0.037***	−0.055***	−0.045***
Agriculture	−0.017***	−0.035***	−0.029***
Parental Status (ref = Together)			
Divorced	−0.040***	−0.108***	−0.119***
Separated	−0.037***	−0.089***	−0.092***
Parent deceased	−0.060***	−0.078***	−0.058***
Household Composition			
# elderly members	0.036***	0.023***	0.001
# children in HH	−0.105***	−0.139***	−0.109***
Has disabled member	−0.030***	−0.006	0.014*
Has unemployed member	0.036***	0.041***	0.024***
Socioeconomic Status			
HH income per capita (000s THB)	0.010***	0.012***	0.008***
Poor (ref = Non-poor)	−0.049***	−0.063***	−0.046***
Extra poor	−0.168***	−0.178***	−0.109***
Region (ref = Central/Bangkok)			
North	−0.038***	−0.021***	0.012*
Northeast	0.038***	−0.071***	−0.133***
South	−0.153***	−0.149***	−0.081***
N	883,313	883,313	883,313
R^2	0.030	0.033	0.037

*Note: Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001. All three specifications estimated simultaneously on N = 883,313.*

(2) Ages 6–11: Logit Results

Table 5 reports average marginal effects from logit models for the five binary malnutrition indicators. Results reinforce and extend the OLS findings. Extended family children are 1.04 percentage points less likely to be stunted and 0.44 percentage points less likely to be underweight than nuclear family children, but 0.54 percentage points more likely to be overweight and 0.41 percentage points more likely to be obese. This dual pattern of reduced undernutrition but increased overnutrition risk is consistent with a grandparent overfeeding dynamic documented in China and Europe (Liu et al., 2021; Barschkett, 2025). Skipped-generation children show the largest protective effect against stunting (−1.77 pp) and underweight (−0.75 pp), but similarly elevated overweight/obesity risk (+0.28–0.34 pp). Single-parent children face significantly higher stunting (+0.60 pp) and underweight (+0.25 pp) probabilities. Notably, the extra-poor group has stunting probability 2.31 percentage points above the non-poor group. The effect of poverty status is the strongest effect across all predictors.

Table 5: Logit Average Marginal Effects - Malnutrition Indicators (Ages 6–11)

Variable	Stunting	Wasting	Under-weight	Overweight	Obese
Household Structure (ref = Nuclear family) - Average Marginal Effects					
Extended family	−0.010***	−0.001	−0.004***	0.005***	0.004***
Single-parent	0.006***	0.001	0.002***	−0.001	−0.004***
Skipped-generation	−0.018***	−0.001	−0.007***	0.003***	0.003***
Selected Controls					
# elderly members	−0.005***	0.000	−0.002***	0.001	0.001
# children in HH	0.010***	0.002***	0.005***	−0.009***	−0.011***
Extra poor (vs non-poor)	0.023***	0.003***	0.011***	−0.011***	−0.011***
Divorced parent	0.000	0.002***	0.003***	−0.009***	−0.012***
South (vs Central)	0.017***	−0.002*	0.008***	−0.007***	−0.010***
N	883,313	883,313	883,313	883,313	883,313

*Note: * p<0.10, ** p<0.05, *** p<0.01. Full control set as in Table 4.*

(3) Ages 12–14: OLS Results

Table 6 reports OLS estimates for older children. Patterns are broadly consistent with the younger age group, with some notable differences. Extended family children still show significantly higher HAZ (+0.055) and WAZ (+0.058). Skipped-generation children have positive HAZ (+0.075) and WAZ (+0.035), but the WHZ coefficient turns negative (−0.023, $p<0.05$). These results suggest that while grandparent care supports growth in height and weight-for-age, older children in grandparent-only homes may have lower weight relative to their height, possibly reflecting dietary constraints on food quality. Male children aged 12–14 have markedly lower HAZ (−0.253 SD) than females, consistent with earlier female pubertal growth completion. The extra-poor effect remains the dominant predictor: −0.164 SD in HAZ and −0.152 SD in WAZ.

Table 6: OLS Regression - Household Structure and Z-scores (Ages 12–14)

Variable	HAZ	WAZ	WHZ
Household Structure (ref = Nuclear family)			
Extended family	0.055***	0.058***	0.024**
Single-parent	−0.025***	−0.026***	−0.012
Skipped-generation	0.075***	0.035***	−0.023*
Selected Controls			
Age (months)	0.0065***	−0.0005*	−0.0044***
Male (=1)	−0.253***	0.017***	0.262***
Undergraduate+ (vs no education)	0.121***	0.065***	−0.011
Extra poor (vs non-poor)	−0.164***	−0.152***	−0.060***
Divorced parent	−0.019***	−0.099***	−0.117***
South (vs Central)	−0.104***	−0.073***	−0.007
Northeast (vs Central)	0.026***	−0.103***	−0.158***
N	380,558	380,558	380,558
R^2	**0.028**	**0.012**	**0.015**

*Note: Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Selected coefficients shown.*

(4) Ages 12–14: Logit Results (Average Marginal Effects)

Table 7 reports average marginal effects from logit models for the five binary malnutrition indicators for children aged 12–14. The pattern of household structure effects is broadly similar to the younger age group but with some important differences in magnitude and significance. Specifically, extended family children remain significantly less likely to be stunted (AME = −0.009 pp, p<0.01) and underweight (−0.005 pp, p<0.01) relative to nuclear family children, and marginally more likely to be overweight and obese (both +0.003 pp, p<0.10). Skipped-generation children are significantly less likely to be stunted (−0.011 pp, p<0.01) and underweight (−0.004 pp, p<0.05), but more likely to be wasted (+0.004 pp, p<0.05); this result is consistent with the WHZ deficit found in the OLS results for this group. Single-parent children face higher stunting risk (+0.005 pp, p<0.01) and lower obesity probability (−0.003 pp). Poverty remains the strongest predictor: extra-poor children are 2.6 pp more likely to be stunted and 1.3 pp more likely to be underweight than non-poor children. Children in the South continues to show elevated stunting risk, while the Northeast shows lower stunting but higher underweight and markedly lower overweight and obesity probabilities. This finding confirms the distinct regional nutritional profiles seen in the OLS estimates.

Table 7: Logit Average Marginal Effects - Malnutrition Indicators (Ages 12–14)

Variable	Stunting	Wasting	Under-weight	Over-weight	Obese
Household Structure (ref = Nuclear family) - Average Marginal Effects					

Extended family	−0.009***	0.001	−0.005***	0.003*	0.003*
Single-parent	0.005***	0.000	0.001	−0.000	−0.003**
Skipped-generation	−0.011***	0.004**	−0.004**	0.000	−0.001
Selected Controls					
# elderly members	−0.003***	0.001	−0.000	0.000	−0.001
# children in HH	0.007***	0.000	0.004***	−0.005***	−0.006***
Extra poor (vs non-poor)	0.026***	0.001	0.013***	−0.006***	−0.005***
Divorced parent	0.002	0.003***	0.005***	−0.008***	−0.009***
South (vs Central)	0.013***	−0.004***	0.003*	−0.000	−0.003*
Northeast (vs Central)	−0.005***	−0.001	−0.004***	−0.012***	−0.015***
N	**380,558**	**380,558**	**380,558**	**380,558**	**380,558**

*Note: *p<0.10, **p<0.05, ***p<0.01. Full control set identical to Table 7 (OLS, ages 12–14). Average marginal effects reported.*

5.2. Modified Models: Grandparent Age Groups and Income Sources (Models 2 & 3)

To disentangle the time and income channels through which grandparent presence affects child nutrition, Table 10 presents two extensions of the baseline OLS model (Table 5). Model 2 disaggregates the aggregate elderly count into four age bands including: (1) 60–64 (Older Adults), (2) 65–74 (Young Old), (3) 75–84 (Middle Old), and (4) 85+ (Oldest Old). Model 3 replaces aggregate per capita income with a set of income-source variables disaggregated by whether they originate from grandparents or other household members, allowing direct identification of which types of grandparent income predict child nutritional outcomes. Both models are estimated on N = 883,313 children aged 6–11 and include the full control set from the baseline model. The results for both models are shown in Table 8.

In model 2, the numbers of grandparents in different age-groups show a clear caregiving-capacity gradient. The "older adults" group (ages 60–64) generates the largest positive associations across all three z-scores (HAZ: +0.050***, WAZ: +0.050***, WHZ: +0.027***), consistent with these grandparents having the physical capacity to provide active, hands-on childcare. The "Young Old" group (65–74) continues to show significantly positive HAZ (+0.039***) and WAZ (+0.026***) associations, but the WHZ effect is no longer significant, suggesting a gradual decline in the quality of short-run nutritional inputs as grandparents age. The "Middle Old" group (75–84) retains a significant positive HAZ association (+0.029***) but shows a significantly negative WHZ coefficient (−0.022***), indicating that while long-run linear growth continues to benefit from their presence, weight-for-height is adversely affected. The Oldest Old group (85+) shows only a marginally significant positive HAZ effect (+0.021*) and a significantly negative WHZ, with no significant WAZ association. Across all age bands, the household structure coefficients remain broadly similar to the baseline: skipped-generation households retain the largest positive HAZ association, and coefficients for extended and skipped-generation households decline only slightly compared to the baseline, suggesting the age-group decomposition does not substantially alter the household structure story.

When taking into account the source of household income, particularly the sources of grandparents' income, there is clear distinction between grandparent earnings that preserve caregiving time and those that displace it. Grandparent agriculture income is positively and

significantly associated with HAZ, but not with WAZ or WHZ, suggesting that flexible agricultural work, which allows grandparents to remain at home and monitor children's meals, supports long-run linear growth. By contrast, grandparent salary income is negatively and significantly associated with both HAZ and WAZ, suggesting that wage employment removing grandparents from reducing caregiving time. Grandparent business income, government allowances, and other income show no statistically significant associations with any z-score. These patterns collectively support the time-channel interpretation: the mechanism through which grandparents improve child nutrition is primarily their caregiving availability, not the income they earn.

Nonetheless, non-grandparent household income retains a significant positive association with all three z-scores, confirming that it is the source of income that determines whether grandparent earnings help or hinder child nutrition. It is important to note that the household structure coefficients in Model 3 are marginally smaller than in Model 2 (e.g., extended family HAZ falls from 0.071 to 0.063), suggesting that income disaggregation absorbs a small portion of the household structure effect but leaves the core finding intact.

Table 8: OLS Results - Modified Models with Grandparent Age Groups and Disaggregated Income Sources (Ages 6–11, N = 883,313)

Variable	Model 2 (Grandparent age groups)			Model 3 (Age groups+ Income sources)		
	HAZ	WAZ	WHZ	HAZ	WAZ	WHZ
Household Structure (ref = Nuclear family)						
Extended family	0.071***	0.074***	0.041***	0.063***	0.065***	0.034***
Single-parent	−0.015***	−0.027***	−0.027***	−0.010*	−0.021***	−0.022***
Skipped-generation	0.112***	0.079***	0.014	0.115***	0.084***	0.018*
Other	0.071***	0.061***	0.024**	0.068***	0.057***	0.022**
No. of Elderly Members by Age Group						
Age 60–64 (Older Adults)	0.050***	0.050***	0.027***	0.051***	0.052***	0.031***
Age 65–74 (Young Old)	0.039***	0.026***	0.002	0.037***	0.025***	0.003
Age 75–84 (Middle Old)	0.029***	0.003	−0.022***	0.025***	−0.001	−0.024***
Age 85+ (Oldest Old)	0.021*	−0.012	−0.034**	0.017	−0.017	−0.037**
Household Income						
HH income per capita (000s THB)	0.010***	0.012***	0.008***	—	—	—
Grandparent Income by Source (Model 3 only)						
Agriculture income	—	—	—	0.003***	0.001	−0.001

Business income	—	—	—	−0.002	−0.000	0.001
Salary income	—	—	—	−0.003***	−0.002*	−0.001
Government allowance	—	—	—	0.007	0.008	0.005
Other income	—	—	—	0.006**	0.004	0.000
Non-grandparent income (total)	—	—	—	0.002***	0.003***	0.002***
Intercept	−0.637***	−0.844***	−1.118***	−0.621***	−0.826***	−1.110***
N	**883,313**	**883,313**	**883,313**	**883,313**	**883,313**	**883,313**
R^2	0.030	0.033	0.037	0.030	0.033	0.037

*Note: *p < 0.05, **p < 0.01, ***p < 0.001. Model 2 uses WHO age-banded elderly counts and aggregate HH income per capita. Model 3 replaces aggregate income with grandparent income by source (agriculture, business, salary, government allowance, other) plus non-grandparent total income. Both models include all controls from Table 4 (individual, education, occupation, parental status, CCT status, region) are included in both models.*

5.3. Results: Causal Effect of Elderly Allowances (DDD)

Table 9 reports Triple Difference (DDD) estimators for the effect of grandparent-received elderly allowances on children's z-scores, estimated separately for age groups 6–7, 8–9, and 10–11. Analysis is restricted to ages 6–11, and within this range, results are reported by three sub-groups to identify age-specific windows of effect.

HAZ results (Panel A). The grandmother allowance DDD estimator (δ_1) is 1.329 ($p<0.01$) for ages 6–7, indicating that children in grandparent-headed households whose grandmother receives the elderly allowance show significantly higher height-for-age z-scores in 2024 relative to 2022 compared to equivalent households without this treatment combination. This effect is not statistically significant for ages 8–9 or 10–11. The grandfather allowance DDD estimator (δ_2) is not significant for any age sub-group in the HAZ specification.

WAZ results (Panel B). Neither grandmother nor grandfather allowance DDD estimators reach statistical significance in any age group for WAZ, suggesting elderly allowances do not translate into improved weight-for-age outcomes through the channels captured here, possibly because food expenditure choices differ from those affecting linear growth.

WHZ results (Panel C). The grandfather allowance DDD estimator (δ_2) is 1.993 ($p<0.001$) for ages 6–7, indicating a significant improvement in weight-for-height z-scores in 2024 for grandchildren in grandfather-guardian households receiving the allowance. No significant WHZ DDD effects are found for older children. The grandmother allowance WHZ estimator is not significant.

The finding that grandmother's allowances affecting HAZ while grandfather's allowances affect WHZ in the youngest children only is consistent with Duflo (2003) and intrahousehold bargaining theory. Grandmothers may prioritize dietary quality and health-seeking behaviors that support long-run linear growth; grandfathers may invest in food quantity that improves short-run weight-height ratios. That both effects disappear for children aged 8 and above confirms the critical window interpretation: nutritional interventions transmitted through income transfers to grandparent caregivers are most effective at the earliest school ages.

Table 9: Triple Difference (DDD) Estimates - Elderly Allowance Effects on Child Z-scores

DDD Estimator	Age 6–7	Age 8–9	Age 10–11
Panel A: Outcome = HAZ (Height-for-Age Z-score)			
Grandma allowance × GP Guardian × Post (δ_1)	1.329**	0.035	0.030
Grandpa allowance × GP Guardian × Post (δ_2)	−0.737	0.009	−0.007
Panel B: Outcome = WAZ (Weight-for-Age Z-score)			
Grandma allowance × GP Guardian × Post (δ_1)	−0.097	0.038	0.033
Grandpa allowance × GP Guardian × Post (δ_2)	0.712	0.036	0.006
Panel C: Outcome = WHZ (Weight-for-Height Z-score)			
Grandma allowance × GP Guardian × Post (δ_1)	−1.454	0.040	0.012
Grandpa allowance × GP Guardian × Post (δ_2)	1.993***	0.036	0.013
N	**129,968**	**240,056**	**243,726**

*Note: Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001. GP Guardian = grandparent is primary guardian (dummy). Post = year 2024 (dummy). All models include controls for individual characteristics, guardian education and occupation, parental status, household composition, income, poverty status, and region. GP Guardian = grandparent is primary guardian. Post = year 2024.*

6. Conclusion, Discussion, and Policy Implications

6.1 Conclusion and Discussion

his study provides large-scale evidence on the relationship between household structure, grandparenting, and child nutritional outcomes among Thailand's most economically vulnerable school-age children. Three main conclusions stand out.

First, grandparent caregiving, both in extended and skipped-generation households, is associated with significantly better height-for-age and weight-for-age outcomes than nuclear family or single-parent arrangements, after controlling comprehensively for income, education, poverty status, and region. This reflects grandparents' role as caregiving time providers and informal safety nets in households with limited economic resources.

Second, grandparents' elderly allowances cause significant improvements in child nutritional z-scores, but only in the youngest children (ages 6–7) and with a gendered pattern: grandmother allowances affect linear growth (HAZ) while grandfather allowances affect weight-for-height (WHZ). This confirms the critical-window hypothesis and supports Duflo's (2003) intrahousehold bargaining framework.

Third, economic status remains the dominant structural predictor of child nutrition: extra-poor children score 0.17–0.18 SD below non-poor children in HAZ and WAZ; these effects are larger

than most household structure effects. Spatial inequality is severe, with deep-South border provinces and parts of the Northeast facing persistently acute nutritional deficits.

The finding that skipped-generation and extended households show better HAZ and WAZ outcomes than nuclear family households, even after controlling for income, education, and poverty status, challenges the widespread assumption that parental absence is uniformly harmful. In Thailand's most economically vulnerable communities, grandparents appear to function as effective nutritional safety nets, particularly through the time channel: their caregiving availability, meal preparation, and health-seeking support contribute positively to child growth.

However, the simultaneous finding that grandparent presence associates with higher overweight and obesity probabilities points to a well-documented overfeeding tendency in grandparent caregiving contexts (Liu et al., 2021; Barschkett, 2025). Grandparents may hold traditional beliefs that equate food quantity with care quality, leading to excess energy intake. This pattern of improving WHZ and simultaneously increasing overnutrition risk is similar to the evidence from China and Europe, and warrants targeted intervention on feeding practices.

The DDD results, demonstrating significant elderly allowance effects only for children aged 6–7, align with the developmental economics literature on critical periods. The first 1,000–3,000 days of life are identified as the window when nutritional inputs have the most lasting structural effects on growth (Hoddinott et al., 2013). By ages 8–11, such effects diminish substantially. This finding suggests that income transfer policies targeting grandparent caregivers are most effective when children are very young.

The grandparent age-gradient results reinforce the time channel interpretation. The fact that younger (60–64) grandparents show the largest positive associations with grandchildren's nutrition outcomes, whereas the effects declining monotonically with grandparent's age, is consistent with physical caregiving capacity, not income, being the main factor. Allowance income, however, provides resources without displacing caregiving time, making it uniquely suited to improve nutrition in this context.

The income/time channel analysis yields a somewhat counter-intuitive result: grandparent salary income is negatively associated with child nutrition, while agricultural income is positive. This suggests that the mechanism through which grandparents benefit children's nutrition is primarily the time channel through their flexibility and caregiving availability rather than the income they earn. Grandparents in wage employment trade caregiving time for income, with net adverse effects on child nutrition. In contrast, the elderly allowance, or transfer income, is different in that it provides income without sacrificing caregiving time, making it uniquely well-suited to improve child nutrition in grandparent-headed households.

6.2 Policy Implications

In light of these findings, the following five policy directions are proposed for consideration by policymakers and stakeholders.

First, given that grandparents are increasingly primary caregivers and that overfeeding is a documented risk, targeted education programs, particularly nutritional literacy, for elderly caregivers are urgently needed. These could be integrated into existing community health infrastructure, such as sub-district health promotion hospitals and community health volunteers, to improve dietary knowledge and age-appropriate feeding practices.

Second, the evidence that elderly allowances transmit benefits to young children in grandparent-headed households supports redesigning cash transfer programs to explicitly account for this intergenerational channel. Conditional cash transfer programs that link grandparent benefits to childcare behaviors, such as health check-up attendance or dietary compliance, could strengthen nutritional impacts compared to unconditional transfers.

Third, the DDD results demonstrate that allowance effects on nutrition are concentrated in children aged 6-7. Policy efforts to expand grandparent-targeted income support or health benefits for households where elderly individuals care for young children should be prioritized, as the opportunity window for nutritional impact narrows rapidly with age.

Fourth, poverty status remains the most significant predictor in this analysis, underscoring the dominant role of economic factors in child health outcomes. This evidence validates the current EEF's Conditional Cash Transfer (CCT) program, and suggests a strategic opportunity to either increase transfer amounts or improve the program's geographic reach.

Fifth, and most importantly, Thailand's aging society trajectory means grandparents are not merely welfare recipients but active producers of the next generation's human capital in vulnerable households. Integrating elderly welfare policy and early childhood development policy as a coherent system could generate broader and more durable social returns on welfare investment.

6.3 Limitations

Several limitations should be acknowledged. First, the sample consists exclusively of economically disadvantaged children in public schools, limiting generalizability to private school students, out-of-school children, and higher-income households. Second, despite the DDD design's advantages, unobservable confounders, such as grandparent personality traits or care orientations, may simultaneously affect allowance eligibility and child nutrition, precluding fully clean causal identification. Third, the absence of direct data on dietary intake, caregiver nutritional knowledge, or healthcare access limits the ability to identify specific causal mechanisms. Fourth, the elderly allowance amounts are modest relative to total household income (~8%), potentially attenuating detectable effect sizes. Future research should use longer panel data tracking individual children, collect qualitative data on grandparent caregiving practices, and extend to pre-school age children in vulnerable households.

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