Eva Ardianah, Diah Indriani, Melaniani Soenarnatalina, Nur Aisiyah Widjaja, Febrina Mustika Santoso
Jurnal Promkes: The Indonesian Journal of Health Promotion and Health Education
Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Socio-Demographic Association with Nutritional Status in Children Aged 8-9 Years Old in Surabaya: Focusing on HAZ Status in Path Analysis

Eva Ardianah[1)], Diah Indriani[1)], Melaniani Soenarnatalina[1)], Nur Aisiyah Widjaja✉[2,3)], Febrina Mustika Santoso[2,3)]

[1] Department of Epidemiology, Biostatistics, Population Studies, and Health Promotion, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia
[2] Child Health Department, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
[3] Child Health Department, Faculty of Medicine, Universitas Airlangga Surabaya, Indonesia
✉Email: nuril08@yahoo.com

ABSTRACT

Background: *Child health, growth, and nutrition are influenced by socioeconomic, cultural, demographic, climatic, nutrition, physical, hygiene, sanitation, medical, and environmental factors. LAZ/HAZ was used to assess the presence of 'stunting' in the population, which indicates chronic malnutrition.* ***Objectives:*** *to investigate the socio-demographics, lifestyle (sleep duration, screen time) and HAZ status of children in 2nd and 3rd grade of elementary school, and the correlation of socio-demographics with the anthropometric parameters.* ***Methods:*** *An observational study with a cross-sectional design was conducted during October – December 2022 in Surabaya, involving healthy children aged 9-10 years old who were in 2nd and 3rd grade of elementary school.* ***Results:*** *BMI-for-age z-score was higher in males than females. Overweight/obesity were prevalent in males (15.16% vs. 10.67%), and underweight and severely underweight were prevalent in females (12.27% vs. 14.23%). The prevalence of stunted/severely stunted was 12.39%. HAZ and WAZ were correlated positively with parental height. The number of children in the household had a negative, weak correlation with HAZ. The maternal education showed that the prevalence of maximal elementary school graduation was higher in stunted children than normal children (29.27% vs. 18.14%, p=0.043). Father's salary below minimum regional wage was more prevalent in stunted and severely stunted (81.71% and 75%, respectively) compared to normal subjects (60%), p=0.007.* ***Conclusion:*** *Socio-demographic factors affecting the prevalence of stunting in children were the father's salary and maternal education. Meanwhile, factors associated with HAZ were parental height and number of children in the household. The effect of socio-demography on HAZ was mediated by parental education, which stimulates household economics and has a further effect on food intake and child anthropometrics.*

Keywords: *child health, growth, nutritional status, socio-demographic*

INTRODUCTION

Children are vulnerable to nutritional disturbances (Bagattini, 2019; Firdaus et al., 2024). Undernutrition in children is still a significant global burden, especially in developing countries such as Indonesia, with the consequences of mortality (Omondi and Kirabira, 2016). The underlying causes are insufficient nutrition intake, including vitamins or minerals, w, directly affect nutritional status (Hastuti et al., 2024). Undernutrition has a detrimental effect on the child's brain development by affecting cognitive development and academic achievement, which affects adulthood productivity (Leroy et al., 2014); undernutrition also influences linear growth and health (Zong et al., 2019; Giyarsih et al., 2021;), with further effect on the quality of life (QoL) (De Grandis et al., 2014).

Undernutrition is divided into underweight, stunted, and wasted (Bhusal and Sapkota, 2022), derived by anthropometric measurements (Kumar et al., 2015) using weight-for-age z-score (WAZ), length/height-for-age z-score (LAZ/HAZ), and weight-for-length/height

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

z-score (WLZ/WHZ) (Sadler et al., 2022). Anthropometry is used to predict the population's nutritional status and monitor its growth, health status (Padilla et al., 2021; Sadler et al., 2022), and nutritional status (Permatasari and Chadirin, 2022). There are three primary indicators for children to monitor the growth: WAZ, LAZ/HAZ and WLZ/WHZ. LAZ/HAZ is defined as the height or length of a child relative to the size or height of a child of the same age in a reference population which, expressed as z-score, was used to assess the presence of 'stunting' in the population (Brainerd and Menon, 2015; Sadler et al., 2022), which indicates chronic malnutrition due to frequent illness or undernutrition for a long time, and is associated with poverty, unhealthy behavior, parenting patterns, not giving exclusive breastfeeding, complementary food and low nutrition practices, infectious disease, low sanitation and hygiene practices (Permatasari and Chadirin, 2022). Undernutrition manifests as stunting, indicating the impairment of human growth rate (Ndemwa et al., 2017).

Child health, growth and nutrition are influenced by socioeconomic, cultural, demographic, and climatic factors (Striessnig and Bora, 2020), nutritional, physical, hygiene and sanitation, medical and environmental (Gebreegziabher and Sidibe, 2024). Socio-demographic factors include maternal age, educational stage (Assefa et al., 2015), parents' income, household behavior and sociocultural practice (Tackie and Asiedu, 2022), religion (Brainerd and Menon, 2015), and children's sex preference (Novella, 2019; Saville et al., 2022). The study focusing on socio-demographic effects toward HAZ in low income countries has been enrolled with various outcomes, such as family income (Rahma and Mutalazimah, 2022), parental education (Gunardi et al., 2017; Kusumajaya et al., 2023), numbers of household (Hussin et al., 2024) and numbers of children in the family were associated with child's HAZ, including the ability to access healthcare services and food intake.

Growth assessment, by measuring height or length, reflects the health and nutritional status because the disturbances of health and nutrition affect the health. Growth assessment also indirectly measures the population's quality of life (Öberg, 2016). Children in the 2nd and 3rd grade of elementary school are one of the vulnerable groups, as it is a preadolescent period, and they still depend on parents for providing their nutritional needs (Fazrin et al., 2022). Here we investigate the socio-demographic and HAZ status of children in 2nd and 3rd grade of elementary school and the correlation of socio-demographics and lifestyle with the anthropometric parameters. Moreover, this study was enrolled in the preadolescence period, which can be used to boost catch-up growth and in optimizing the development to correct and maintain quality of life the next generation. Not many studies have been carried out on this period in Indonesia, with most focusing on children under 5 years old (Huriah et al., 2019; Bahagia Febriani et al., 2020; Soekatri et al., 2020 Mulyaningsih et al., 2021;Kasajja et al., 2022). The difference of our study from others is highlighted in the path analysis and can be used for the government to set a law in order to reduce stunting prevalence in Surabaya.

METHODS

Study and Subjects

An observational study with a cross-sectional design was conducted during October – December 2022 involving eight elementary schools in Surabaya, which was determined with simple random sampling. The study involved healthy children aged 9-10 years old who were in the 2nd and 3rd grades of elementary school. The study was conducted with the permission of the school's principals. Inclusion criteria were children in 2nd and 3rd grade of elementary school, with no plans for moving to other cities; parents permitted their children to take part in the research by signing informed consent and information for consent when they were gathered in the school under the head master's supervision and cooperation. Exclusion criteria were no permission from parents and not collaborative, had chronic disease when the study was enrolled (tuberculosis, congenital heart disease), children with mental retardation or disability.

Anthropometric Measurements

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Anthropometric measurements were enrolled with minimal clothes and accessories, including body weight (seca robusta 813), body height (seca stadiometer 213), waist circumference (seca 201 measuring tape) and mid-upper arm circumference (upper arm circumference band). For measuring weight (all attributes are removed, except clothes, including shoes, socks, belt, tie, hairpin and so on), the subject was asked to step on the scale in a straight position (seca robusta 813 digital scale can detect a weight gain of 10 g). Meanwhile, measurements of body height (seca stadiometer 213) were carried out in a straight position, and then the head positioner was pulled down until it touched the subject's head. The height was then recorded according to the scale position.

Statistical Analysis

Test of normality was enrolled, followed by independent sample T-test or Mann-Whitney U-test and one way ANOVA or Kruskal-Wallis test (further differences were assessed using LSD) for ratio or interval data. The categorical data were examined using the Pearson chi-square or Fischer exact tests. The correlation was enrolled using Pearson or Spearman's Rho correlation. All the statistical analysis was enrolled using SPSS ver. 21 (IBM, US). The further effect was analyzed using SEM with smartPLS 4.0 as the analysis tool. There were several variables contributing to HAZ, including:

1. Parental education consists of maternal and paternal last education degree.
2. Household economy consists of parental income.
3. Food recall consists of a food frequency questionnaire or FFQ.
4. Child anthropometrics consist of the child's body weight and body height.
5. Household factors, including the number of children in a household and the number of household members.
6. Parental height, including maternal and paternal height.

Ethical Clearance

This study received approval of the Ethics Committee (309/EC/KEPK/FKUA/2023), which was released on 2 November 2023 by the Faculty of Medicine, Airlangga University, Surabaya, Indonesia.

RESULTS AND DISCUSSION

A total of 1084 children in the 2nd grade and 3rd grade from nine public elementary schools followed the screening process from October to November 2022. Only 1,060 subjects had complete body weight and height measurements. The subjects' characteristics are summarized in table 1.

The prevalence of stunted/ severely stunted, underweight/ severely underweight and overweight/obesity was 10.94%, 13.58% and 16.70%, respectively, based on HAZ, WAZ and BMI-for-age z-score.

Children are prone to malnutrition due to the high demand for nutrients during the growth and development period (Govender et al., 2021). The prevalence of undernutrition in our study is more than 10%, while in South East Ethiopia, stunting is still prevalent (32.1%), while underweight is 9%, and wasted 7%, which suggests the high prevalence of chronic malnutrition over a long period (Ararsa et al., 2023). The Malaysian National Survey noted the prevalence of stunted 16.1%, wasting/severely wasting 10.61% and overweight 7.3% (Lee et al., 2022).

Table 1. Subjects' characteristics

Subjects' characteristics	Male (n=554)	Female (n=506)	P value
Age in months, mean + SD	107.44 + 7.77	107.40 + 7.89	0.943[c]
Body weight in kg, mean + SD	29.61 + 12.44	28.14 + 8.33	0.070[c]
WAZ, mean + SD	-0.11 + 1.85	-0.33 + 1.57	0.151[c]
WAZ categories, n(%)			
Obese	34 (6.14%)	8 (1.58%)	0.003[a]
Overweight	50 (9.03%)	46 (9.09%)	
Normal weight	379 (68.41%)	369 (72.92%)	
Underweight	58 (10.47%)	63 (12.45%)	

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Subjects' characteristics	Male (n=554)	Female (n=506)	P value
Severely underweight	14 (2.53%)	9 (1.78%)	
NA	19 (3.43%)	11 (2.17%)	
Body height in cm, mean + SD	127.97 + 8.75	128.40 + 7.25	0.830[c]
HAZ, mean + SD	-0.69 + 1.09	-0.67 + 1.11	0.846[c]
HAZ categories, n(%)			0.868[a]
Tall	6 (1.08%)	4 (0.79%)	
Normal	487 (87.91%)	447 (88.34%)	
Stunted	53 (9.57%)	50 (9.88%)	
Severely stunted	8 (1.44%)	5 (0.99%)	
BMI-for-age, mean + SD	0.30 + 1.94	-0.04 + 1.58	0.018[c]
BMI-for-age categories, n(%)			<0.0001[b]
Obese	48 (8.66%)	8 (1.58%)	
Overweight	64 (11.55%)	57 (11.26%)	
Normal weight	393 (70.94%)	392 (77.47%)	
Underweight	46 (8.30%)	46 (9.09%)	
Severely underweight	3 (0.54%)	3 (0.59%)	
Waist circumference in cm, mean + SD	60.73 + 10.76	59.23 + 9.17	0.110[c]
Dominance hand arm circumference in cm, mean + SD	20.23 + 4.05	20.37 + 8.63	0.465[c]

[a]Pearson chi square test; [b]Fischer's exact test; [c]Mann Whitney U test

There was no significant difference in age distribution, body weight, WAZ, body height, HAZ, HAZ category, waist circumference, and arm circumference between male and female subjects. But BMI-for-age z-score was higher in males than females (0.30 + 1.94 vs -0.04 + 1.58, p=0.018), while overweight and obesity were prevalent in males (15.16% vs 10.67%), and underweight and severely underweight were prevalent in females (12.27% vs 14.23%), p<0.0001.

A study investigating the difference between men and women suggests that women are thinner than men due to the reduction of energy expenditure in men as a consequence of their occupation (Maruyama and Nakamura, 2018). A study in Malay showed that males are more likely to be overweight, while females tend to be underweight; as the difference in perception of their figure, the overweight is an ideal model for males, while underweight is an ideal model for female (Kuan et al., 2011). Another study also showed a similar perception: when the girls were underweight, they were more satisfied than normal weight and overweight (p < 0.001). So, in regard to BMI, body satisfaction is related to sex perception (Kantanista et al., 2017). Even female adolescents (10-19 years old) who are already underweight believe they need to lose weight (Hijji et al., 2021). Others noted age's involvement in body perception and sex (Weng et al., 2023). Sub-Saharan children also found the opposite trend; female was associated with the preventive effect of being underweight (prevalent ratio or PR=0.66) and stunted (PR=0.63) but at higher risk of being overweight (PR=1.60) than males due to less exercise (Darling et al., 2020).

Table 2. The difference in subjects' characteristics based on HAZ categories

Subjects' characteristics	Tall (n=6)	Normal (n=711)	Stunted (n=82)	Severely stunted (n=8)	P value
Age, mean + SD in months	102.00 + 6.39	106.40 + 7.54	110.45 + 8.97	115.63 + 9.94	0.000[a]
Sex, n(%)					
Male	3 (50%)	377 (53.02%)	43 (53.75%)	5 (62.5%)	0.971[b]
Female	3 (50%)	334 (46.98%)	39 (47.56%)	3 (37.5%)	
Body weight, mean + SD in kg	49.40 + 7.53	29.38 + 8.93	21.48 + 3.47	18.98 + 2.44	0.000[a]
Body height, mean + SD, in cm	143.92 + 3.39	128.87 + 8.01	119.22 + 3.57	114.56 + 4.32	0.000[a]
Waist circumference, mean + SD in cm	80.00 + 6.85	60.44 + 10.14	53.35 + 5.53	51.00 + 2.39	0.000[a]
Mid upper arm	26.43 +	20.34 + 3.92	19.49 +	17.10 + 2.23	0.000[a]

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Subjects' characteristics	Tall (n=6)	Normal (n=711)	Stunted (n=82)	Severely stunted (n=8)	P value
circumference, mean ± SD, in cm	26.43		18.65		
BMI-for-age z-score, mean ± SD	2.96 ± 1.41	0.27 ± 1.78	-0.86 ± 1.33	-1.30 ± 0.79	0.000[a]
BMI-for-age z-score, n(%)					
Obese	2 (33.33%)	37 (5.20%)	2 (2.44%)	0 (0%)	
Overweigh	2 (33.33%)	94 (13.22%)	1 (1.22%)	0 (0%)	
Normal	2 (33.33%)	523 (72.56%)	64 (78.05%)	7 (87.5%)	0.000[b]
Underweight	0 (0%)	53 (7.45%)	15 (18.29%)	1 (12.5%)	
Severely underweight	0 (0%)	4 (0.56%)	0 (0%)	0 (0%)	
Parent's marriage status, n(%)					
Married	6 (100%)	667 (93.81%)	76 (92.68%)	6 (75%)	0.185[b]
Single parents	0 (0%)	44 (6.19%)	6 (7.31%)	2 (25%)	
Number of children in the family, n(%)					
> 3 children	6 (100%)	606 (85.23%)	71 (86.59%)	8 (100%)	0.759[b]
< 3 children	0 (0%)	105 (14.77%)	11 (13.41%)	0 (0%)	
Number of family members, n(%)					
> 5 people	6 (100%)	493 (69.34%)	61 (74.39%)	6 (75%)	0.507[b]
< 5 people	0 (0%)	218 (30.66%)	21 (29.27%)	2 (25%)	
Father's height, mean ± SD in cm	168.33 ± 3.67	167.09 ± 5.75	164.58 ± 5.44	168.75 ± 8.54	0.007[a]
Father's occupation, n(%)					
- Civil servant	1 (16.67%)	9 (1.27%)	1 (1.22%)	0 (0%)	0.242[b]
- Private sector employee	3 (50%)	478 (67.23%)	61 (74.39%)	6 (75%)	
- Policeman/Indonesian National Army	0 (0%)	10 (1.41%)	0 (0%)	0 (0%)	
- Businessman	1 (16.67%)	155 (21.80%)	13 (15.85%)	0 (0%)	
- Medical personnel	0 (0%)	4 (0.56%)	0 (0%)	0 (0%)	
- Jobless	1 (16.67%)	20 (2.81%)	3 (3.66%)	1 (12.5%)	
- Scavenger	0 (0%)	1 (0.14%)	0 (0%)	0 (0%)	
- Working odd job	0 (0%)	6 (0.84%)	1 (1.22%)	0 (0%)	
- Construction laborer	0 (0%)	2 (0.28%)	0 (0%)	0 (0%)	
- Massage	0 (0%)	1 (0.14%)	0 (0%)	0 (0%)	
- Driver	0 (0%)	1 (0.14%)	1 (1.22%)	0 (0%)	
- No data	0 (0%)	22 (3.09%)	2 (2.44%)	1 (12.5%)	
Father's salary, n(%)					
- Below the minimum wage	5 (83.33%)	433 (60.90%)	67 (81.71%)	6 (75%)	0.007[b]
- Above the minimum wage	1 (16.67%)	252 (35.44%)	13 (15.85%)	1 (12.5%)	
- No wage	0 (0%)	2 (0.28%)	0 (0%)	0 (0%)	
- No data	0 (0%)	22 (3.09%)	2 (2.44%)	1 (12.5%)	
Father's last education, n(%)					
- Did not graduate from elementary school	0 (0%)	15 (2.11%)	1 (1.22%)	2 (25%)	0.067[b]
- Elementary school	0 (0%)	86 (12.10%)	17 (20.73%)	1 (12.5%)	
- Junior high school	0 (0%)	102 (14.35%)	16 (19.51%)	0 (0%)	
- Senior high school	3 (50%)	388 (54.57%)	41 (50%)	4 (50%)	
- 3-year diploma	0 (0%)	25 (3.52%)	0 (0%)	0 (0%)	
- Bachelor degree	3 (50%)	69 (9.70%)	6 (7.32%)	1 (12.5%)	
- Master's degree/ post-doctoral	0 (0%)	6 (0.84%)	0 (0%)	0 (0%)	
- No data	0 (0%)	15 (2.11%)	1 (1.22%)	0 (0%)	
Mother's height, mean ± SD in cm	160.50 ± 6.25	155.56 ± 5.97	152.20 ± 5.44	151.00 ± 3.39	0.000[a]

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Subjects' characteristics	Tall (n=6)	Normal (n=711)	Stunted (n=82)	Severely stunted (n=8)	P value
Mother's occupation					
- Civil servant	1 (16.67%)	10 (1(.41%)	2 (2.44%)	0 (0%)	0.222[b]
- Private sector employee	1 (16.67%)	133 (18.71%)	14 (17.07%)	2 (25%)	
- Businesswoman	0 (0%)	99 (13.92%)	11 (13.41%)	0 (0%)	
- Medical personnel	1 (16.67%)	11 (1.55%)	0 (0%)	0 (0%)	
- Not working	3 (50%)	447 (67.09%)	54 (65.85%)	5 (62.5%)	
- Work aboard	0 (0%)	1 (0.42%)	0 (0%)	0 (0%)	
- Laundry	0 (0%)	1 (0.42%)	0 (0%)	0 (0%)	
- Servant	0 (0%)	2 (0.28%)	0 (0%)	0 (0%)	
- No data	0 (0%)	7 (0.98%)	1 (1.22%)	1 (12.5%)	
Mother's salary					
- Below the minimum wage	1 (16.67%)	178 (25.04%)	23 (28.05%)	2 (25%)	0.217[b]
- Above the minimum wage	2 (33.33%)	78 (10.97%)	5 (6.10%)	0 (0%)	
- No wage	3 (50%)	447 (67.09%)	53 (64.63%)	5 (62.5%)	
- No data	0 (0%)	8 (1.13%)	1 (1.22%)	1 (12.5%)	
Mother's last education					
- Did not graduate from elementary school	0 (0%)	14 (1.97%)	3 (3.66%)	1 (12.5%)	0.043[b]
- Elementary school	0 (0%)	115 (16.17%)	21 (25.61%)	0 (0%)	
- Junior high school	0 (0%)	111 (15.61%)	12 (14.63%)	1 (12.5%)	
- Senior high school	3 (50%)	377 (53.02%)	37 (45.12%)	5 (62.5%)	
- 3-year diploma	0 (0%)	19 (2.67%)	3 (3.66%)	0 (0%)	
- Bachelor degree	3 (50%)	66 (9.28%)	5 (6.10%)	0 (0%)	
- Master's degree/ post-doctoral	0 (0%)	1 (0.42%)	0 (0%)	0 (0%)	
- No data	0 (0%)	8 (1.13%)	1 (1.22%)	1 (12.5%)	
WAZ, mean ± SD	3.46 ± 1.20	-0.01 ± 1.61	-2.11 ± 1.01	-3.22 ± 0.63	0.000[a]

[a]Kruskal Wallis; [b]Fischer's exact test; significant in the level of α<0.05. Note: no data due to death or divorce.

The researchers' questionnaire was filled out by 807 children, including 423 males and 379 females, as summarized in **Table 2.** The maternal education showed that the prevalence of maximal elementary school graduation was higher in stunted children than normal children (29.27% vs. 18.14%, p=0.043).

Tall subjects were significantly heavier, and had bigger waist circumference, mid-upper arm circumference, BMI-for-age and WAZ than normal subjects (p-value <0.05). Tall subjects were also significantly younger than stunted subjects, while body weight, body height, waist circumference, mid-upper arm circumference WAZ, BMI-for-age and maternal height were significantly bigger than stunted subjects (p<0.05). Tall subjects also were significantly younger than severely stunted subjects. At the same time, body weight, body height, waist circumference, mid-upper arm circumference WAZ, BMI-for-age and maternal height were significantly bigger than stunted subjects (p<0.05). Tall subjects also had longer screen time than severely stunted subjects (p<0.05).

Normal subjects had more considerable body height, weight, mid-upper arm circumference, waist circumference, WAZ, HAZ, and BMI-for-age z-score than stunted subjects (p<0.05). Parental height (maternal and paternal) was significantly higher in normal subjects compared to stunted (p<0.05) and compared with severely stunted, normal subjects had significantly bigger body height, body weight, mid-upper arm circumference, waist circumference, WAZ, HAZ, and BMI-for-age z-score. No significant difference was seen in parental high (p>0.05), sleep duration and screen time.

No significant difference was seen in waist circumference, mid-upper arm circumference and BMI-for-age between stunted and severely stunted subjects, but there was a substantial difference in body weight, body height, WAZ and HAZ between stunted and severely stunted

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

subjects (p<0.05). Parental height, screen time and sleep duration showed no significant difference (p>0.05).

A literature review highlighted the maternal role during the golden age of children: preconception, the prenatal, and the infant-toddlerhood phase, which includes fulfilling the nutritional requirements during those phases and optimizing a positive environment for optimal growth and development (Saleh et al., 2021). Another study noted higher maternal and paternal education associated with the prevention of undernutrition, with a stronger association with maternal education than paternal education (Vollmer et al., 2017). There is an association between maternal education and the prevalence of stunting due to the mother's role in fulfilling the child's nutrition from conception to childhood via shaping food intake and providing the right well with meal planning and preparation (Saleh et al., 2021). Maternal education may shape maternal perception of identifying healthy food for their children. The study found that mothers with a high education consume more fruit and vegetables and have breakfast daily than those with a lower education (Ansem et al., 2017).

Maternal perception will give healthy feeding behavior to their children, as seen in a study that showed maternal positive attitude including consuming fruits and vegetables while limiting sweets with positive persuasions; mother also perceives the responsibility toward the child's food intake and monitoring the food consumption, including junk food restriction, and exerts pressure to eat (Jellmayer et al., 2017). A meta-analysis found that higher maternal education had a protective effect toward growth faltering in children in middle-income and low-educated populations. But this association did not exist in high-income countries (Rezaeizadeh et al., 2024).

Father’s salary below minimum regional wage was high in stunted and severely stunted (81.71% and 75%, respectively) compared to normal subjects (60%), p=0.007. The significance of the low salary in stunted/severely stunted children indicates the role of the father's salary toward the incidence of stunting. A systematic review noted the prevalence of families with low income was 71%, and there was a relationship between family income and stunted toddlers (Rahma and Mutalazimah, 2022). Others also found that the increment of minimum wages when the children were born, they had higher HAZ during the first five years of life, particularly in male infants (Majid and Behrman, 2023).

The reason for the difference in income between stunted and normal children is due to the access to healthcare services and the ability to buy food for the family. A study in Malaysia noted that most poor-income households had food insecurity issues (52.8%), including 23.3% with mild food insecurity, 14.3% with moderate food insecurity, and 9.6% with severe food insecurity (Alam et al., 2019). The findings in England and Scotland also highlight a similar issue: food insecurity is a constant factor in low-income parents (Shinwell and Defeyter, 2021), associated with underweight (OR=3.82) and stunted (AOR=6.7) (Betebo et al., 2017). Large families put an extra burden on food consumption and have a higher risk of experiencing food insecurity than small households; the burden worsens with more young or school-going children (Akello and Mwesigwa, 2023). Food insecurity also causes nutrient deficiency, such as anemia and protein deficiency in children. Household income is also correlated with food security issues in Sri Lanka (Akello and Mwesigwa, 2023). A study noted the correlation between parental education and food security which also correlated with the children's body mass index (BMI) (Javadi et al., 2023). Based on those findings, household size and parental education level might be relevant factors in the linkage of the father's income and HAZ status. Others found that the incidence of underweight was correlated with low household income (OR=2.0) and having more than six children (OR=1.8) (Hijji et al., 2021).

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Table 3. Spearman's Rho correlation for anthropometric parameters and socioeconomic lifestyle variables

Variables	HAZ		WAZ		BMI-for-age z-score	
	r	p	r	p	r	p
Maternal height	0.242	0.000	0.148	0.000	0.074	0.049
Paternal height	0.183	0.000	0.116	0.003	0.053	0.143
Number of children	-0.129	0.000	-0.093	0.009	-0.065	0.063
Number of household	-0.028	0.426	-0.009	0.794	-0.005	0.893

Table 3 summarizes the correlation between anthropometric parameters and socioeconomic and lifestyle variables. HAZ and WAZ were correlated positively and weakly with maternal height and paternal height, while the number of children in the household had a negative, weak correlation. BMI-for-age z-score only correlated very weakly with maternal height. Screen time showed a very weak correlation with WAZ.

There was a positive association between HAZ children with maternal and paternal height, which was in line with other children. HAZ was associated with maternal height (β=0.047; 95% CI [0.043-0.050]) and paternal height (β=0.022; 95% CI [0.018-0.025]) (Wu et al., 2021). Others also supported this by stating that maternal height has a stronger association with childhood stunting (OR=2.85 for short mothers) than paternal height and socioeconomic influences (Gupta et al., 2021). It was also found that the relationship between mother-offspring was stronger than father-offspring for height, so children with the shortest parents had the risk for stunting by 3.23 times (95% CI [2.83-3.68]) compared to tallest parents (Wu et al., 2021). Other highlight factors include disease incidence, parental education, and family income (Coetzee et al., 2020). A study in Indonesia found no relationship between the father's height and stunting but a moderate positive correlation with the mother's height (Sindhughosa and Arimbawa, 2020). Others found the correlation of wealth and maternal height with stunted and underweight. Underweight was associated with maternal education (Mutisya et al., 2016).

There was a relationship between the number of children in a household with HAZ and WAZ. Our suggestion related to this issue was correlated with food security in households, as household food security score was associated with WAZ (r=0.352, p=0.008) and HAZ (r=0.299, p=0.027) (Sindhughosa and Arimbawa, 2020). Unfortunately, we did not assess the food security in our study. A study in Nicaragua underlined an important finding that mild household food insecurity had a detrimental effect on child's health, although the effect was age-dependent. But when food insecurity is experienced during early childhood, it might be harmful (Schmeer and Piperata, 2017). Food insecurity in this context is economic access to food.

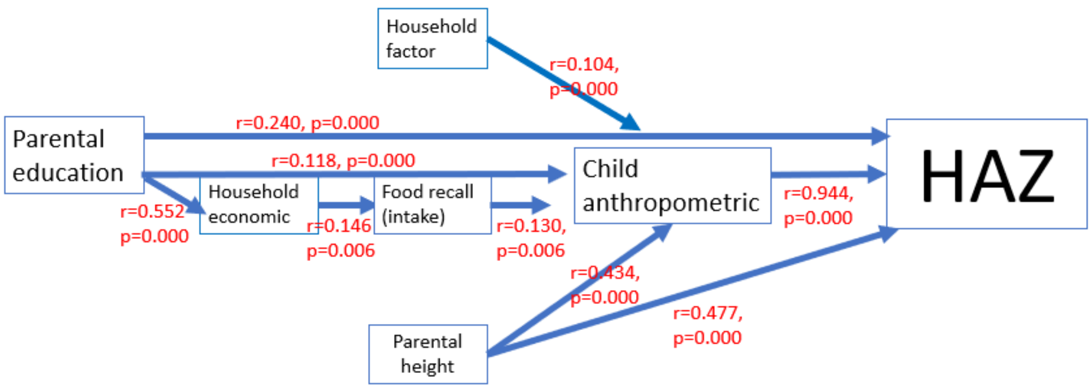

Figure 1. Path analysis of the effect of socioeconomics on HAZ

Figure 1 summarizes the path analysis indicating the effect of socioeconomic factors on HAZ. The role of socioeconomic factors on HAZ seems to be

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

via the child's anthropometric (body weight, body height), in which parental education affects the household economy and food intake and directly affects the child's anthropometrics and HAZ. While household factors indirectly affect HAZ via child anthropometrics, parental height had a direct effect on the child's anthropometrics and HAZ.

Our path analysis revealed that parental education had direct effects on HAZ, or indirectly via body weight and body height, and also via household economics that affected food intake and further impact on body weight and body height before HAZ. A study found that a similar study using the least squares model noted the impact of parental education on HAZ via household economics. Still, the effect was more significant on maternal education than paternal education, especially in countries with a high burden of undernutrition (Alderman and Headey, 2017). A study noted the importance of household socioeconomic condition as the strongest predictor of stunting and parental nutritional status (Shuvo et al., 2024). Household income has a significant role in determining the adequate food intake of the family (Öberg, 2016) and quality food (French et al., 2019), which is strengthened by other findings: monthly household income was significantly associated with energy intake (p=0.000, r=0.817), protein (p=0.000, r=0.614), fat (p=0.000, r=0.486), carbohydrate (p=0.000, r=0.692), iron (p=0.000, r=0.373), zinc (p=0.000, r=0.511), and vitamin A (p=0.027, r=0.221) (Okinarum et al., 2022). As is known, adequate intake during childhood, supported by a good environment creates healthy growth that allows children to reach their potential genetic height. A study in Indonesia noted the indirect relationship of household income with undernutrition via dietary diversity score. It was logical, as the low income under minimum wage affected the ability to purchase food. This condition correlated with the food security in the household and the ability to access diverse food for each individual in the family (Hastuti et al., 2024). Food security affects the intake of certain nutrients (Mei et al., 2020). A country study noted the correlation between the "household food group expenditure index" with the increment of child's HAZ and BMI in several countries, including Ethiopia, India and Vietnam. Dietary diversity was associated with BMI-for-age z-score and significantly increased from 5 to 8 years (Humphries et al., 2017).

A study using Gomez analysis implied the increment of family size (number of household members) also increases undernutrition, and the correlation was linked with the child's age (D'Souza et al., 2013). Meanwhile a study in Botswana found that several children (birth order) and household size hurt a child's health (Mmopelwa, 2019), and explorative data stated that families with ≥ 3 children under-five tend to have undernutrition (Shuvo et al., 2024). However, our findings didn't correlate the involvement of nutrient's intake in the path analysis.

Our study noted the effect of parental height on child body weight and body height (child anthropometrics) and directly affecting HAZ. A study indicated that short maternal height had the strongest association with child stunting (OR=4.4) (Shuvo et al., 2024). Using linear regression, a study highlighted the role of parental anthropometry on their offspring's weight and length at two years of age; and maternal and paternal height was negatively associated with general adiposity and abdominal obesity in children, indicating the protective role in the incidence of obesity in their offspring (Donnelly et al., 2024). At the same time, a perinatal study found that paternal height could predict the incidence of small gestational age (SGA) (Takagi et al., 2019). Using demographic health survey (DHS) data, it was noted that parental height was associated with child HAZ, and that children with short parental height had the risk to be stunted by 1.56 to 1.89-times, with a more significant effect of maternal height than paternal height (Wu et al., 2021).

High prevalence of infections among children living in poor areas of developing countries impairs linear growth in these populations. Acute, invasive infections, which provoke a systemic response (e.g., dysentery and pneumonia), and chronic infections, which affect the host over a sustained period (e.g., gut helminth infections), have a substantial effect on linear growth.

Limitations

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

The study had many limitations on socio-demographic characteristics, such as family disease history, especially infectious disease such as tuberculosis, to find the cause of stunting. Stephensen (1999) stated that high prevalence of infections such as acute and invasive type (dysentery and pneumonia) provoke the systemic immune response, while chronic type affecting children over a sustained time (such as helminth) impairs linear growth (Stephensen, 1999). History of respiratory disease in children also contributed to low HAZ (Tadesse and Mekonnen, 2020). Meanwhile diarrhea (frequency and duration) increase the risk of stunting (Abri et al., 2022). We also didn't assess the food security issue which is affected by socioeconomics.

As the study was enrolled during preadolescent period to identify nutritional disturbances, it would be advantageous to boost the health policy, including healthy habits and eating behavior in this period to tackle the health problems in the community, so that the prevalence of non-communicable diseases, especially those involving with metabolic alterations, can be reduced in the future.

CONCLUSION

Socio-demographic factors affecting the prevalence of stunting in children were the father's salary and maternal education. Meanwhile, factors associated with HAZ were parental height and number of children in the household. The effect of socio-demographics on HAZ was mediated by parental education, which stimulates household economics and has a further effect on food intake and child anthropometrics.

REFERENCES

Abri, N., Thaha, A.R., Jafar, N., 2022. Relationship Between Economic Status, Infectious Diseases and Urinary Iodine Excretion with Stunting Incidence of Elementary School Children in IDD Endemic Areas, Enrekang Regency. J. Heal. Nutr. Res. 1, 133–139. https://doi.org/10.56303/jhnresearch.v1i3.21

Akello, M.C., Mwesigwa, D., 2023. Household Size and Household Food Security in Ngetta Ward, Lira City, Northern Uganda International Journal of Developing Country Studies ISSN. Int. J. Dev. Ctry. Stud. 5, 88–109.

Alam, M., Siwar, C., Wahid, A.N.M., Talib, B.A., 2019. Food secirity and low-income households in the Malaysian East Coast Economic Region: an empirical analysis. Rev. Urban Reg. Dev. Stud. 11, 2–15.

Alderman, H., Headey, D.D., 2017. How Important is Parental Education for Child Nutrition? World Dev. 94, 448-464. https://doi.org/10.1016/j.worlddev.2017.02.007

Ansem, W.J.C. Van, Schrijvers, C.T.M., Rodenburg, G., Mheen, D. Van De, 2017. Maternal Educational Level and Children's Healthy Eating Behaviour: Role of the Home Food Environment (Cross-Sectional Results from the INPACT Study). Pediatr. Behav. Nutr. Factors 197–220. https://doi.org/10.1201/9781315365732-18

Ararsa, G.G., Getachew, M.T., Diddana, T.Z., Alemayehu, F.R., 2023. Prevalence of undernutrition and associated factors among children aged 6-23 months: A cross-sectional analysis from South-East Ethiopia. J. Nutr. Sci. 12, 1–22. https://doi.org/10.1017/jns.2023.109

Assefa, H., Belachew, T., Negash, L., 2015. Socio-demographic factors associated with underweight and stunting among adolescents in Ethiopia. Pan Afr. Med. J. 20, 252. https://doi.org/10.11604/pamj.2015.20.252.3588

Bagattini, A., 2019. Children's well-being and vulnerability. Ethics Soc. Welf. 13, 211–215. https://doi.org/10.1080/17496535.2019.1647973

Bahagia Febriani, A.D., Daud, D., Rauf, S., Nawing, H.D., Ganda, I.J., Salekede, S.B., Angriani, H., Maddeppungeng, M., Juliaty, A., Alasiry, E., Artaty, R.D., Lawang, S.A., Ridha, N.R., Laompo, A., Rahimi, R., Aras, J., Sarmila, B., 2020. Risk factors and nutritional profiles associated with stunting in children. Pediatr. Gastroenterol. Hepatol. Nutr. 23, 457-463. https://doi.org/10.5223/PGHN.2020.23.5.457

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Betebo, B., Ejajo, T., Alemseged, F., Massa, D., 2017. Household Food Insecurity and Its Association with Nutritional Status of Children 6-59 Months of Age in East Badawacho District, South Ethiopia. J. Environ. Public Health 2017, 6373595. https://doi.org/10.1155/2017/6373595

Bhusal, U.P., Sapkota, V.P., 2022. Socioeconomic and demographic correlates of child nutritional status in Nepal: an investigation of heterogeneous effects using quantile regression. Global. Health 18, 1–13. https://doi.org/10.1186/s12992-022-00834-4

Brainerd, E., Menon, N., 2015. Religion and Health in Early Childhood: Evidence from South Asia. Popul. Dev. Rev. 41, 439–463. https://doi.org/10.1111/j.1728-4457.2015.00067.x

Coetzee, D., du Plessis, W., van Staden, D., 2020. Longitudinal effects of stunting and wasting on academic performance of primary school boys: The north-west child-health-integrated-learning and development study. South African J. Child. Educ. 10, 1–9. https://doi.org/10.4102/sajce.v10i1.863

D'Souza, R.S., Sheela, A.M., D, R.J., 2013. Impact of Socio-Economic Factor on Child Development Among Urban Poor - a Study in Bangalore , India. Eur. Sci. J. 9, 175–188.

Darling, A.M., Sunguya, B., Ismail, A., Manu, A., Canavan, C., Assefa, N., Sie, A., Fawzi, W., Sudfeld, C., Guwattude, D., 2020. Gender differences in nutritional status, diet and physical activity among adolescents in eight countries in sub-Saharan Africa. Trop. Med. Int. Heal. 25, 33–43. https://doi.org/10.1111/tmi.13330

De Grandis, E.S., Armelini, P.A., Cuestas, E., 2014. Evaluation of quality of life in schoolchildren with a history of early severe malnutrition. An. Pediatría (English Ed. 81, 368–373. https://doi.org/10.1016/j.anpede.2013.11.011

Donnelly, J.M., Walsh, J.M., Horan, M.K., Mehegan, J., Molloy, E.J., Byrne, D.F., McAuliffe, F.M., 2024. Parental Height and Weight Influence Offspring Adiposity at 2 Years; Findings from the ROLO Kids Birth Cohort Study. Am. J. Perinatol. 41, 422–428. https://doi.org/10.1055/s-0041-1740299

Fazrin, I., Daha, K.K., Musa, K. lImron, 2022. The Role of Parents in Preparing Balanced Menu with Children's Nutritional Status. J. Nurs. Pract. 5, 229–238. https://doi.org/10.30994/jnp.v5i2.149

Firdaus, Santy, W.H., Setiyowati, E., Putri, R.A., Damawiyah, S., 2024. Analysis of Social Demography, Behavioral Hygiene, Breast Milk, and Nutritional Status in Children With Diarrhea in Surabaya City. Rev. Gest. Soc. e Ambient. 18, 1–17. https://doi.org/10.24857/rgsa.v18n5-066

French, S.A., Tangney, C.C., Crane, M.M., Wang, Y., Appelhans, B.M., 2019. Nutrition quality of food purchases varies by household income: The SHoPPER study. BMC Public Health 19, 1–7. https://doi.org/10.1186/s12889-019-6546-2

Gebreegziabher, T., Sidibe, S., 2024. Determinants of household-, maternal- and child-related factors associated with nutritional status among children under five in Mali: Evidence from a Demographic and Health Survey, 2018. Public Health Nutr. 27, 1–13. https://doi.org/10.1017/S1368980024000363

Giyarsih, S.R., Putri, R.F., Aji, M.M.S., Jayanti, Y.A., Darmawan, F., Wahidin, D., 2021. Socioeconomic and Demographic Characteristics of Children Under Five Years of Age Suffering from Stunting in Magelang Regency, Indonesia. Populasi 29, 16. https://doi.org/10.22146/jp.71683

Govender, I., Rangiah, S., Kaswa, R., Nzaumvila, D., 2021. Malnutrition in children under the age of 5 years in a primary health care setting. South African Fam. Pract. 63. https://doi.org/10.4102/safp.v63i1.5337

Gunardi, H., Soedjatmiko, S., Sekartini, R., Medise, B.E., Darmawan, A.C., Armeilia, R., Nadya, R., 2017. Association between parental socio-demographic factors and declined linear growth of young children in Jakarta. Med. J. Indones. 26, 286–292. https://doi.org/10.13181/mji.v26i4.1819

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Gupta, A., Cleland, J., Sekher, T. V., 2021. Effects of parental stature on child stunting in India. J. Biosoc. Sci. 54, 605–616. https://doi.org/10.1017/S0021932021000304

Hastuti, V.N., Afifah, D.N., Sugianto, D.N., Anjani, G., Noer, E.R., 2024. Socio-demographics, dietary diversity score, and nutritional status of children aged 2-5 years: A cross-sectional study of Indonesian coastal areas. Clin. Epidemiol. Glob. Heal. 27, 101599. https://doi.org/10.1016/j.cegh.2024.101599

Hijji, T.M., Saleheen, H., AlBuhairan, F.S., 2021. Underweight, body image, and weight loss measures among adolescents in Saudi Arabia: is it a fad or is there more going on? Int. J. Pediatr. Adolesc. Med. 8, 18–24. https://doi.org/10.1016/j.ijpam.2020.01.002

Humphries, D.L., Dearden, K.A., Crookston, B.T., Woldehanna, T., Penny, M.E., Behrman, J.R., 2017. Household food group expenditure patterns are associated with child anthropometry at ages 5, 8 and 12 years in Ethiopia, India, Peru and Vietnam. Econ. Hum. Biol. 26, 30–41. https://doi.org/10.1016/j.ehb.2017.02.001

Huriah, T., Fitriami, E., Erviana, Rahman, A., 2019. The Prevalence and Associated Factors of Stunting Children in Rural Area, Yogyakarta, Indonesia, in: Third International Conference on Sustainable Innovation 2019 – Health Science and Nursing (IcoSIHSN 2019) The. pp. 134–138. https://doi.org/10.2991/icosihsn-19.2019.30

Hussin, N., Mamat, N.L., Halib, H., Yen, W.C., 2024. Association between Socio-demographic Factors with Nutritional Status among Primary School Children in Setiu, Terengganu, Malaysia. J. Gizi dan Pangan 19, 153-162. https://doi.org/10.25182/jgp.2024.19.supp.1.153-162

Javadi, M., Pakbin, B., Ziaeeha, M., Barikani, A., Brück, W.M., 2023. Household Food Security and Demographic Factors in Children and Their Parents. J. Nutr. Food Secur. 8, 58–65. https://doi.org/10.18502/jnfs.v8i1.11765

Jellmayer, K., De Piano Ganen, A., Alvarenga, M., 2017. Influence of behavior and maternal perception on their children's eating and nutritional status. Mundo da Saude 41, 180–193. https://doi.org/10.15343/0104-7809.20174102180193

Kantanista, A., Król-Zielińska, M., Borowiec, J., Osiński, W., 2017. Is Underweight Associated with more Positive Body Image? Results of a Cross-Sectional Study in Adolescent Girls and Boys. Span. J. Psychol. 20, 1-6. https://doi.org/10.1017/sjp.2017.4

Kasajja, M., Nabiwemba, E., Wamani, H., Kamukama, S., 2022. Prevalence and factors associated with stunting among children aged 6–59 months in Kabale district, Uganda. BMC Nutr. 8, 1-7. https://doi.org/10.1186/s40795-022-00578-9

Kuan, P., Ho, H., Shuhaili, M., Siti, A., Gudum, H., 2011. Gender Differences in Body Mass Index, Body Weight Perception and Weight Loss Strategies among Undergraduates in Universiti Malaysia Sarawak. Malays. J. Nutr. 17, 67–75.

Kumar, D., Goel, N.K., Kalia, M., Mahajan, V., 2015. Socio-demographic Factors Affecting the Nutritional Status of the Under Three Children in Chandigarh, UT. Heal. J. 6, 46–52.

Kusumajaya, A.A.N., Mubasyiroh, R., Sudikno, S., Nainggolan, O., Nursanyoto, H., Sutiari, N.K., Adhi, K.T., Suarjana, I.M., Januraga, P.P., 2023. Socio-demographic and Healthcare Factors Associated with Stunting in Children Aged 6-59 Months in the Urban Area of Bali Province, Indonesia 2018. Nutrients 15, 389.

Lee, W.S., Jalaludin, M.Y., Khoh, K.M., Kok, J.L., Nadarajaw, T., Soosai, A.P., Mukhtar, F., Fadzil, Y.J., Anuar Zaini, A., Mohd-Taib, S.H., Rosly, R.M., Khoo, A.J., Cheang, H.K., 2022. Prevalence of undernutrition and associated factors in young children in Malaysia: A nationwide survey. Front. Pediatr. 10, 913850. https://doi.org/10.3389/fped.2022.913850

Leroy, J.L., Ruel, M., Habicht, J.P., Frongillo, E.A., 2014. Linear growth deficit continues to accumulate beyond the first 1000 days in low- and

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

middle-income Countries: Global evidence from 51 national surveys. J. Nutr. 144, 1460–1466. https://doi.org/10.3945/jn.114.191981
Majid, M.F., Behrman, J.R., 2023. Minimum Wages around Birth and Child Health. World Bank Econ. Rev. 37, 351–365. https://doi.org/10.1093/wber/lhad004
Maruyama, S., Nakamura, S., 2018. Why are women slimmer than men in developed countries? Econ. Hum. Biol. 30, 1–13. https://doi.org/10.1016/j.ehb.2018.04.002
Mei, C.F., Faller, E.M., Chuan, L.X., Gabriel, J.S., 2020. Household income, food insecurity and nutritional status of migrant workers in Klang valley, Malaysia. Ann. Glob. Heal. 86, 1–10. https://doi.org/10.5334/aogh.2859
Mmopelwa, D., 2019. Household size, birth order and child health in Botswana Household size, birth order and child health in Botswana. Cent. Res. Econ. Dev. Int. Trade, Univ. ofNottingham 19, 1–44.
Mulyaningsih, T., Mohanty, I., Widyaningsih, V., Gebremedhin, T.A., Miranti, R., Wiyono, V.H., 2021. Beyond personal factors: Multilevel determinants of childhood stunting in Indonesia. PLoS One 16, 1–19. https://doi.org/10.1371/journal.pone.0260265
Mutisya, M., Kandala, N.B., Ngware, M.W., Kabiru, C.W., 2016. Household Food (In)Security and Nutritional Status of Urban Poor Children Aged 6 to 23 Months in Kenya. Food Secur. Child Malnutrition Impact Heal. Growth, Well-Being 31, 53–71. https://doi.org/10.1201/9781315365749-4
Ndemwa, M., Wanyua, S., Kaneko, S., Karama, M., Anselimo, M., 2017. Nutritional status and association of demographic characteristics with malnutrition among children less than 24 months in Kwale County, Kenya. Pan Afr. Med. J. 28, 265. https://doi.org/10.11604/pamj.2017.28.265.12703
Novella, R., 2019. Parental education, gender preferences and child nutritional status in Peru. Oxford Dev. Stud. 47, 29–47. https://doi.org/10.1080/13600818.2018.1495703
Öberg, S., 2016. Height as a measure of the nutritional status and health of a population. Food, Popul. Heal. – Glob. Patterns Challenges. Proc. an Interdiscip. Symp. Dyn. from Prehistory to Present 79.
Okinarum, G.Y., Yunita, F.A., Hardiningsih, H., Fauziah, A., Mustamu, A.C., 2022. Monthly household income and intake of nutrients among adolescent females in a rural setting of Indonesia. Int. J. Health Sci. (Qassim). 6, 675–683. https://doi.org/10.53730/ijhs.v6ns4.5620
Omondi, D., Kirabira, P., 2016. Socio-Demographic Factors Influencing Nutritional Status of Children (6-59 Months) in Obunga Slums, Kisumu City, Kenya. Public Heal. Res. 6, 69–75. https://doi.org/10.5923/j.phr.20160602.07
Padilla, C.J., Ferreyro, F.A., Arnold, W.D., 2021. Anthropometry as a readily accessible health Assessment of Older adults. Exp. Gerontol. 153, 111464. https://doi.org/10.1016/j.exger.2021.111464
Permatasari, T.A.E., Chadirin, Y., 2022. Assessment of undernutrition using the composite index of anthropometric failure (CIAF) and its determinants: A cross-sectional study in the rural area of the Bogor District in Indonesia. BMC Nutr. 8, 1-20. https://doi.org/10.1186/s40795-022-00627-3
Rahma, I.M., Mutalazimah, M., 2022. Correlation between Family Income and Stunting among Toddlers in Indonesia: A Critical Review, in: Proceedings of the International Conference on Health and Well-Being (ICHWB 2021). pp. 78–86. https://doi.org/10.2991/ahsr.k.220403.011
Rezaeizadeh, G., Mansournia, M.A., Keshtkar, A., Farahani, Z., Zarepour, F., Sharafkhah, M., Kelishadi, R., Poustchi, H., 2024. Maternal education and its influence on child growth and nutritional status during the first two years of life: a systematic review and meta-analysis. eClinicalMedicine 71, 102574. https://doi.org/10.1016/j.eclinm.2024.102574

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Vol. 13 Issue 1 SI, January 2025, 1-15 *doi: 10.20473/jpk.V13.I1SI.2025.1-15*

Sadler, K., James, P.T., Bhutta, Z.A., Briend, A., Isanaka, S., Mertens, A., Myatt, M., O'Brien, K.S., Webb, P., Khara, T., Wells, J.C., 2022. How Can Nutrition Research Better Reflect the Relationship Between Wasting and Stunting in Children? Learnings from the Wasting and Stunting Project. J. Nutr. 152, 2645–2651. https://doi.org/10.1093/jn/nxac091

Saleh, A., Syahrul, S., Hadju, V., Andriani, I., Restika, I., 2021. Role of Maternal in Preventing Stunting: a Systematic Review. Gac. Sanit. 35, S576–S582. https://doi.org/10.1016/j.gaceta.2021.10.087

Saville, N.M., Harris-Fry, H., Marphatia, A., Reid, A., Cortina-Borja, M., Manandhar, D.S., Wells, J.C., 2022. Differences in maternal and early child nutritional status by offspring sex in lowland Nepal. Am. J. Hum. Biol. 34, 1–19. https://doi.org/10.1002/ajhb.23637

Schmeer, K.K., Piperata, B.A., 2017. Household food insecurity and child health. Matern. Child Nutr. 13, 1-13. https://doi.org/10.1111/mcn.12301

Shinwell, J., Defeyter, M.A., 2021. Food Insecurity: A Constant Factor in the Lives of Low-Income Families in Scotland and England. Front. Public Heal. 9, 1–14. https://doi.org/10.3389/fpubh.2021.588254

Shuvo, S. Das, Khatun, A., Zahid, M.A., Josy, M.S.K., Paul, D.K., 2024. Exploring the factors associated with undernutrition among 6–59 months children residing in slum areas of the south-western region, Bangladesh. J. Hunger Environ. Nutr. 1-6. https://doi.org/10.1080/19320248.2024.2384996

Sindhughosa, W.U., Arimbawa, I.M., 2020. Association between parents' body height with stunting in children ages 1-5 years old in Nagi Primary Health Care Working Area Larantuka City, East Flores, Indonesia. Intisari Sains Medis 11, 315–319. https://doi.org/10.15562/ism.v11i1.567

Soekatri, M.Y.E., Sandjaja, S., Syauqy, A., 2020. Stunting was associated with reported morbidity, parental education and socioeconomic status in 0.5–12-year-old Indonesian children. Int. J. Environ. Res. Public Health 17, 1-9. https://doi.org/10.3390/ijerph17176204

Stephensen, C.B., 1999. Burden of infection on growth failure. J. Nutr. 129, 534-538. https://doi.org/10.1093/jn/129.2.534s

Striessnig, E., Bora, J.K., 2020. Under-Five Child Growth and Nutrition Status: Spatial Clustering of Indian Districts. Spat. Demogr. 8, 63–84. https://doi.org/10.1007/s40980-020-00058-3

Tadesse, S.E., Mekonnen, T.C., 2020. Prevalence and Associated Factors of Stunting Among Children Aged 6-59 Months in Delanta District; North East Ethiopia. Nutr. Diet. Suppl. 12, 41–48. https://doi.org/10.2147/nds.s237407

Takagi, K., Iwama, N., Metoki, H., Uchikura, Y., Matsubara, Y., Matsubara, K., Nishigori, H., Saito, M., Fujiwara, I., Sakurai, K., Kuriyama, S., Arima, T., Nakai, K., Yaegashi, N., Sugiyama, T., 2019. Paternal height has an impact on birth weight of their offspring in a Japanese population: The Japan Environment and Children's Study. J. Dev. Orig. Health Dis. 10, 542–554. https://doi.org/10.1017/S2040174418001162

Vivian Tackie, Christiana Asiedu, 2022. Socio- economic status and household practices influence on undernutrition among children under five years in the Effutu municipality. Int. J. Sci. Technol. Res. Arch. 3, 159–171. https://doi.org/10.53771/ijstra.2022.3.1.0074

Vollmer, S., Bommer, C., Krishna, A., Harttgen, K., Subramanian, S. V., 2017. The association of parental education with childhood undernutrition in low- and middle-income countries: Comparing the role of paternal and maternal education. Int. J. Epidemiol. 46, 312-323. https://doi.org/10.1093/ije/dyw133

Weng, H.C., Chang, S.M., Hsu, J.C., Yang, Y.N., Lin, C.Y., 2023. Age and gender differences in misperceptions of body shape in a Taiwanese population. J. Eat. Disord. 11, 1-11. https://doi.org/10.1186/s40337-023-00837-5

Wu, H., Ma, C., Yang, L., Xi, B., 2021. Association of Parental Height With

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025

Offspring Stunting in 14 Low- and Middle-Income Countries. Front. Nutr. 8. https://doi.org/10.3389/fnut.2021.650976

Zong, X.N., Li, H., Zhang, Y.Q., Wu, H.H., 2019. Child nutrition to new stage in China: Evidence from a series of national surveys, 1985-2015. BMC Public Health 19, 1–13. https://doi.org/10.1186/s12889-019-6699-z

Received: 25-10-2024, Accepted: 05-12-2024, Published Online: 08-01-2025