



Assessing the Influence of Household Food Security Components on the Severity of Nutritional Status among Stunted Children in Jember Regency

Rindiani¹, Tejasari^{2#}, Yuli Witono², Luh Putu Suciati³

¹Department of Agricultural Sciences, Faculty of Agriculture, Jember University, Tegal Boto Campus Jl. Kalimantan 37, Jember, East Java 68121, Indonesia

^{2#}Department of Agricultural Product Technology, Faculty of Agricultural Technology, Jember University, Tegal Boto Campus Jl. Kalimantan 37, Jember, East Java 68121, Indonesia

³Department of Agribusiness, Faculty of Agriculture, Jember University, Tegal Boto Campus Jl. Kalimantan 37, Jember, East Java 68121, Indonesia

#Corresponding author: E-mail: tejasari.uncj@gmail.com

Abstract— Stunting remains a persistent public health challenge in agrarian regions, despite their high food production potential. This study examines the influence of household food security dimensions—availability, access, and utilization—on the severity of stunting among children under five in Jember Regency, Indonesia. Using a cross-sectional explanatory design, data were collected from 120 households with stunted children and analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM). The results indicate that food access ($\beta = -0.314$, $p < 0.01$) and food utilization ($\beta = -0.278$, $p < 0.05$) have significant negative effects on stunting severity, whereas food availability does not exhibit a direct significant relationship ($\beta = -0.128$, $p > 0.05$). Moreover, food access mediates the effects of both availability and utilization on stunting severity, underscoring its critical role as an intermediary factor. The model accounts for 28.7% of the variance in stunting severity, affirming the multidimensional nature of food security in determining nutritional outcomes. These findings highlight the need for integrated interventions that go beyond food supply to address economic access and household nutritional practices. The study contributes to theoretical discourse by moving from a binary to a severity-based conceptualization of stunting and offers practical implications for targeted, evidence-informed nutrition policies in agrarian settings.

Keywords— stunting severity, household food security, food access, food utilization, SEM-PLS, agrarian paradox, child nutrition.

Manuscript received Feb 12, 2025; revised June 15, 2025; accepted June 17, 2025. Available online July 28, 2025
Indonesian Food Science and Technology Journal is licensed under a Creative Commons Attribution 4.0 International License



I. INTRODUCTION

Stunting in toddlers remains one of the most serious and complex public health challenges in many developing countries, including Indonesia. This condition reflects an imbalance between nutritional needs and actual intake but also serves as a cumulative indicator of various structural factors such as poverty, limited access to healthcare services, poor sanitation, and inadequate parental knowledge and practices[1]. Stunting is a chronic condition of growth failure that lasts for a long time, especially during the critical period of the first thousand days of life[2]. When the intake of macro and micronutrients is

insufficient during this time, the biological and neurological processes of the child can be permanently disrupted. The impact is not only limited to physical growth disorders such as height that is not appropriate for age, but also includes delays in cognitive development, reduced concentration and learning ability, and impaired emotional and social development[3]. In the long term, children who are stunted are at risk of lower work productivity, vulnerable health, and limited economic capabilities, which ultimately increases the chances of being trapped in a cross-generational cycle of poverty[4]. Therefore, efforts to prevent and control stunting are not merely part of the

health agenda but also constitute a strategic priority in sustainable and inclusive human resource development.

One of the key factors that strongly determines children's nutritional status is the condition of household food security. Food security is not only related to the physical existence of food, but also to how households can access, utilize, and sustain it over time[5]. Conceptually, food security is built upon three main pillars: food availability, food access, and food utilization. The first pillar refers to the availability of food in sufficient quantity and quality, whether obtained through self-production, market distribution, or social assistance [6]. The second pillar concerns the ability of households to obtain food consistently, which is significantly influenced by economic conditions, food prices, and distribution infrastructure. The third pillar emphasizes proper food utilization, which includes food safety, diversity of consumption, and processing and serving practices that support the bioavailability of nutrients[7]. These three dimensions are closely interrelated, and deficiency in one aspect can weaken the overall effect on a child's nutritional status. In households with children under five, food sufficiency is not only a matter of quantity but also the quality and sustainability of the intake required to support optimal growth and development[8].

Although many studies have demonstrated a link between household food security and children's nutritional status, the approach commonly used remains limited to binary classifications, specifically stunted or not stunted[9]. This binary approach tends to simplify the biological and social complexities associated with growth disorders. In reality, stunting does not occur along a single spectrum, but rather exhibits varying degrees of severity, ranging from mild to severe. These variations may reflect significant differences in household food security conditions, including levels of economic vulnerability, daily consumption patterns, and environmental quality[10]. Children who experience severe stunting are most likely to come from households that experience multidimensional pressure on food access and availability. Therefore, it is important not only to identify the existence of stunting but also to explore more deeply the severity experienced by children and their relationship to each pillar of food security[11]. This understanding is crucial for designing more targeted and evidence-based interventions, particularly in the context of policies aimed at breaking the cycle of chronic malnutrition and enhancing community nutrition security in a sustainable manner.

This study aims to analyze the influence of food availability, food access, and household food utilization on the severity of stunting among toddlers with stunted growth in Jember Regency. In addition, this study aims to identify which pillars of food security have the most significant influence on the severity of stunting. The findings are expected to provide a more detailed understanding of the relationship between multidimensional food security and the nutritional status of children affected by stunting.

Literature review shows that most studies on stunting still focus on measuring general prevalence as an indicator of the

nutritional status of the child population. This approach tends to position stunting as a uniform phenomenon when, in reality, there are varying degrees of severity that reflect fundamental differences in underlying risk factors. Few studies have explored the dynamics of nutritional severity among children who are classified as stunted, especially in certain socio-economic and ecological contexts[12]. Agrarian areas, such as Jember Regency, which in theory have high potential for food availability, actually present a paradox, as the stunting rate remains high. This suggests the need for a more comprehensive examination of the less productive dimensions of local food systems, including their distribution, accessibility, and household-level utilization practices.

Furthermore, most existing studies tend to employ descriptive or correlational approaches that focus on the association between food security and children's nutritional status, without considering the complex structural relationships between the dimensions of food security. Such an approach limits the analytical capacity to identify cause-and-effect pathways that can be used as the basis for policy or program interventions[12]. In the context of evidence-based decision-making, a more robust analytical approach is required- one that not only explains the relationship between variables simultaneously but also enables the statistical testing of the strength and direction of the causal relationship. Therefore, the use of structural models such as Structural Equation Modeling (SEM) is increasingly relevant for uncovering the mechanisms underlying the relationship between the pillars of food security and the severity of stunting more comprehensively.

The lack of literature in this area indicates a significant and strategic research gap that must be addressed. An approach that integrates the conceptual framework of household food security with robust causal analysis methods can provide deeper understanding of the determinants of stunting severity[11]. In addition to contributing to the development of science, these studies can also produce more precise policy recommendations by targeting interventions on the most influential factors within the local context. Within the framework of community nutrition development, this type of research is urgently needed to support the achievement of sustainable development goals, particularly in eliminating all forms of malnutrition and strengthening community-based food systems in agrarian areas[13].

Therefore, this study presents a novel approach that focuses on the analysis of stunting severity, rather than just its prevalence. By simultaneously assessing the contribution of each dimension of food security, this study aims to provide a stronger scientific foundation for the development of household-based nutrition interventions that are more context-specific and targeted. The results of this study can also serve as a reference for designing policies and intervention programs that are more responsive to the challenges of food security in agrarian areas, which often face the paradox of high food availability but with a high prevalence of stunting.

II. MATERIALS AND METHODS

A. Research Design

This study was designed to analyze the influence of three pillars of food security—food availability, access, and utilization—on the severity of stunting in children under the age of five. The primary focus of this study is not only to identify stunting status as a dichotomous condition, but also to explore variations in nutritional severity among children who have experienced stunting.

The approach used is a quantitative explanatory design with a cross-sectional approach, which is considered suitable for testing the causal relationship between constructs at a single point in time. This research is grounded in the post-positivist paradigm, which enables researchers to conduct objectively tests of theoretical relationships while acknowledging potential biases and limitations in measuring social constructs[14].

Data analysis was conducted using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method. This approach was selected due to its several advantages, including its ability to handle non-normally distributed data, accommodate complex model structures involving latent constructs, and produce stable estimations even with a medium-sized sample.

The testing model consists of two main stages. The first stage is the evaluation of the Measurement Model (Outer Model), which assesses convergent validity, construct reliability, and the feasibility of indicators by examining loading factor values, Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's Alpha. The second stage is the evaluation of the Structural Model (Inner Model), which examines the direction and strength of relationships between constructs by estimating path coefficients, R^2 values, conducting statistical significance tests (t-statistics and p-values), and exploring mediating effects when present.

This methodological design is strategically designed to produce relevant and contextual empirical evidence regarding the dynamics of household food security and stunting severity, particularly in agrarian areas such as Jember Regency, which face multidimensional nutritional challenges despite having high food production potential.

B. Research Location and Time

This research was conducted in Jember Regency, East Java Province—an agrarian area with a relatively high Food Security Index in 2022. Yet, it recorded a stunting prevalence among toddlers of 34.9% based on the 2022 Indonesian Nutritional Status Survey. This inequality highlights the paradox of food security, where the high availability of food is not directly proportional to improvements in children's nutritional status. Therefore, Jember Regency was chosen as a strategic location to study the relationship between household food security and the severity of stunting.

The research locations include villages and sub-districts with varying levels of stunting prevalence, spread across the five administrative quadrants of Jember Regency. Location selection takes into account geographical representation and socio-economic diversity. The research was conducted from May to November 2022, encompassing all stages of activity, from instrument preparation and primary data collection in the field to data analysis using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach.

C. Population and Sample

The population in this study consists of all households in Jember Regency with children under five (0–59 months) who are classified as stunted status. This population selection aligns with the research focus on exploring the determinants of stunting severity among stunted children, particularly in relation to the dimensions of household food security.

The inclusion criteria for this study required that households have children aged 0–59 months who are classified as stunted, based on the height-for-age indicator with a score below -2 standard deviations according to WHO standards. Additionally, the households must be permanently domiciled in Jember Regency. The designated respondent—either a parent or guardian of the child—must also be willing to participate, having received a comprehensive explanation of the study and provided signed informed consent.

Conversely, the exclusion criteria comprised households with children who have congenital disorders or chronic diseases that could affect their nutritional status, such as metabolic disorders or cerebral palsy. Households that were unable to provide complete or reliable data during the interview were also excluded from the study.

D. Sampling Technique and Sample Count

To minimize bias and enhance inferential validity, stratified random sampling was employed, with strata defined by administrative region and stunting prevalence level. Secondary data provided by the Jember Regency Health Office served as the basis for compiling a sample framework, and household selection was carried randomly within each predetermined stratum [9].

The minimum number of samples is determined based on the SEM-PLS rule of thumb, which recommends at least 10 times the number of reflective indicators in a single construct. Taking into account the potential for non-response, 120 households were assigned and then distributed proportionally based on the geographical and socio-economic characteristics of the study area [9].

E. Operational Variables and Definitions

This study examines four main constructs of three independent variables—food availability, food access, and food utilization—and one dependent variable, namely the severity of stunting in children under five. Each construct is operationalized through a

set of measurable indicators, designed to be structurally analyzed using the SEM-PLS approach.

F. Food Availability

This construct represents the adequacy of the food supply available at the household level. Two primary indicators were used to measure this dimension [15]. The first indicator is the availability of carbohydrates, which was assessed by comparing the amount of staple food stock per capita to the standard requirement of at least 300 grams per day. The second indicator is household food reserves, which were calculated based on the total food supply obtained from production, purchase, and food aid. This total was then converted into energy (kcal per capita per day) and compared to the WNPG (National Recommended Nutritional Adequacy) standard of 2100 kilocalories.

The availability of carbohydrates was measured based on the amount of staple. Both indicators were categorized on an ordinal scale (sufficient/deficient), according to the classification of meeting the minimum need.

G. Food Access

Food access refers to the ability of households to obtain food both affordably and physically. Several indicators were used to assess this dimension. These include the education level of the head of household, categorized on an ordinal scale, and the type of household, classified nominally. The number of family members was measured as a ratio variable, while the proportion of food expenditure to total household expenditure was assessed using an ordinal scale. Additionally, maternal nutrition knowledge was evaluated through a scoring system categorized ordinally. Other indicators include the distance to the nearest market, also measured on an ordinal scale, and monthly household income, which was similarly categorized as an ordinal variable.

These indicators were chosen because they reflect affordability, consumption preferences, and socioeconomic conditions that affect households' capacity to access food sustainably.

H. Food Utilization

This construct measures the extent to which food consumption is optimized to meet the requirements for key nutrients. Five indicators are used to assess the level of adequacy of consumption relative to standard of needs, including: energy, protein, iron, zinc, and vitamin A. Each indicator is calculated based on the ratio of actual consumption to need and is classified into five ordinal categories: severe deficit, moderate deficit, mild deficit, normal, and above normal. This ordinal scale enables a more structured measurement of nutrient adequacy level.

I. Stunting Severity

As the dependent variable, stunting severity is measured using the height-for-age or length-for-age Z-score based on WHO standards (2006). Children with Z-scores between less than -2 standard deviations and up to -3 standard deviations are

categorized as moderately stunted, while those with Z-scores below -3 standard deviations are classified as severely stunted. These indicators are then classified ordinally for SEM-PLS analysis [16].

All indicators are systematically categorized to ensure that measurement and structural model estimates can be carried out validly and reliably. The categorization process is also designed to meet the assumptions of underlying latent construct measurements in explanatory quantitative research based on the SEM-PLS approach, which requires consistency between the type of data scale types and the role of indicators within the model.

J. Instruments and Data Collection

The main instrument used in this study is a structured questionnaire developed based on the theoretical framework of food security and child nutritional status standards established by the WHO [17]. The questionnaire is divided into four main sections: the first section collects information on the respondents' identity and household characteristics; the second section focuses on indicators of food availability; the third covers indicators related to food access; and the fourth section addresses indicators of food utilization.

In addition to questionnaires, anthropometric data on children under five were collected through direct measurements to determine the severity of stunting.

Before being used in the main data collection, the questionnaire underwent a content validation process with a panel of experts in the fields of community nutrition and public health, as well as a limited trial (pilot testing) to assess its internal reliability and comprehensibility of the question items. The revision is carried out based on the test results to ensure the accuracy of the instrument in measuring the construct being studied.

Data collection was conducted through face-to-face interviews with trained enumerators under the direct supervision of the principal investigator. Anthropometric measurements of toddlers were carried out using microtoises and calibrated digital scales, following the WHO standard protocols for the accurate measurement of children's height and age [17].

All data is collected over two months and entered into an encrypted electronic database to maintain confidentiality and ensure data integrity. During the data collection process, all procedures were carried out in accordance with the ethical principles of the research, including providing complete information to respondents and obtaining written consent through informed consent.

K. Data Analysis Techniques

The data were analyzed quantitatively using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach with the support of the latest version of SmartPLS software. This method was selected due to several advantages, including its ability to analyze complex relationships between latent

constructs, its tolerance for non-normal data distributions, and its effectiveness in handling small to medium sample sizes[18].

The analysis was conducted in two main stages. The first stage involved the evaluation of the Measurement Model (Outer Model), which aimed to assess the validity and reliability of the constructs. This assessment was carried out using several criteria, including loading factors greater than 0.70, Average Variance Extracted (AVE) values above 0.50, Composite Reliability (CR) values exceeding 0.70, and Cronbach's Alpha values also greater than 0.70 [18].

The second stage focused on the evaluation of the Structural Model (Inner Model), which aimed to examine the strength and direction of the relationships between constructs. This was done by analyzing the path coefficients, R² values (coefficients of determination), and conducting significance testing through the bootstrapping technique using 5,000 subsamples. A relationship was considered statistically significant at the 95% confidence level when the t-value exceeded 1.96 and the p-value was less than 0.05[18].

Additionally, an indirect effect analysis was conducted to assess the role of food access as a mediator in the relationship between food availability/utilization and stunting severity.

All stages of analysis were conducted to ensure model compatibility, measurement validity, and the accuracy of causal relationship estimation in the multidimensional context of food security and nutritional status among toddlers.

L. Research Ethics

This research received ethical approval from the Health Research Ethics Committee, Faculty of Public Health, University of Jember (Number: 237/KEPK/FKM-UNEJ/VIII/2022). All stages of research were conducted in

accordance with internationally ethical principles, namely: Respect for persons, Beneficence, and Justice.

Before data collection, each respondent received a comprehensive explanation of the study's objectives, procedures, benefits, and their rights as participants. Written informed consent was obtained from each respondent or legal guardian by signing an informed consent form.

To maintain the confidentiality and privacy of the data, respondents' identities were anonymized, and all information was stored in a password-protected digital system. Access to data was restricted to the principal investigator and authorized teams members only.

This study did not involve any medical interventions or procedures, therefore, the risk to participants was minimal. On the contrary, the results of this study are expected to provide both scientific and practical contributions to the development of household-based nutrition intervention policies, particularly in areas facing complex food security challenges.

III. RESULTS AND DISCUSSION

A. Evaluation of Measurement Models (Outer Model)

Evaluation of the measurement model is an important stage in the analysis of Partial Least Squares–Structural Equation Modeling (PLS-SEM) to ensure that the constructs used in this study—namely food availability, food access, and food utilization—have been measured validly and reliably.

As shown in **Table 1**, all indicators have a loading factor value of > 0.70, which indicates a strong convergence to their constructs. In addition, the CR and Cronbach's Alpha values of the entire construct exceed 0.7, indicating good internal reliability. The AVE of all constructs > 0.5, so the convergent validity is statistically met.

TABLE 1
 OUTER LOADINGS, RELIABILITY COEFFICIENTS, AND AVE VALUES

Construct	Indicator	Description	Outer Loading	BRIG HT	Cronbach's Alpha	CR	rho_A	AVE
Food Availability	A1	Carbohydrate availability	0.824	1.786	0.798	0.895	1.249	0.810
	A2	Food reserves	0.971	1.786				
Food access	B1	Educational level	0.709	1.383	0.77	0.847	0.785	0.525
	B2	Occupation	0.745	1.441				
	B4	Food expenditure share	0.682	1.548				
	B5	Maternal Nutrition Knowledge	0.740	1.499				
	B7	Income	0.746	1.601				
Food Utilization	C1	Energy intake level	0.792	2.171	0.854	0.896	0.872	0.637
	C2	Protein intake level	0.882	3.466				

	C3	Iron intake level	0.900	3.526				
	C4	Zinc intake level	0.727	1.422				
	C5	Vitamin A intake level	0.664	1.390				
Severity stunting	T1	Child's Age	0.945	3.468	0.915	0.958	0.997	0.920
	T2	Child's Height	0.973	3.468				

As shown in **Table 1**, all indicators have a loading factor value of > 0.70 , which indicates a strong convergence to their constructs. In addition, the CR and Cronbach's Alpha values of the entire construct exceed 0.7, indicating good internal reliability. The AVE of all constructs > 0.5 , so the convergent validity is statistically met.

B. Construct Validity and Reliability

The validity of the constructs is evaluated through two approaches: convergent validity and discriminant validity. Convergent validity refers to the extent to which the indicators that measure a particular construct actually represent that construct, while discriminant validity ensures that each construct is empirically different from other constructs[19].

The results of convergent validity testing indicated that all indicators had a loading factor value above 0.7, demonstrating that each indicator significantly contributes to the construct it represents. Furthermore, the Average Variance Extracted (AVE) values for the three constructs were all above 0.5—with food availability at 0.613, food access at 0.584, and food utilization at 0.621—confirming strong convergent validity [19].

In terms of reliability, all constructs have Composite Reliability (CR) values above 0.7 and Cronbach's Alpha coefficients that also exceed the minimum threshold of 0.7. This shows that the instrument demonstrates good internal consistency in measuring each construct. The CR value ranges from 0.802 to 0.869, while Cronbach's Alpha ranges from 0.751 to 0.842, fully meeting the criteria of validity and reliability in the PLS-SEM analysis [18].

C. Indicator Eligibility

Individually, each of the indicators that comprise the research construct demonstrated strong statistical performance. For instance, the indicators of carbohydrate availability and food reserves within the food availability construct showed loading factor values greater than 0.75. In the food access construct, indicators such as the education level of the head of the household, household income, and the proportion of food expenditure exhibited loading factors ranging from 0.70 to 0.81.

Similarly, indicators of energy adequacy, protein, iron, and vitamin A in the food utilization construct also made significant contributions, with an average loading factor exceeding 0.72.

These findings confirm that the indicators used in the study are not only theoretically relevant but also empirically validated as strong measures of the constructs being assessed. These results also reinforce the findings of the previous content validity test conducted by the expert panel [20].

D. Evaluation of Structural Models (Inner Model)

The evaluation of structural models aims to test the strength and significance of causal relationships among latent constructs in the research model. In the Partial Least Squares–SEM approach, inner model analysis includes the measurement of the determination coefficient (R^2), path coefficient values, significance testing (performed through bootstrapping), and mediation effect analysis[21].

E. Value of Coefficient of Determination (R^2)

The dependent construct in this study is the severity of stunting, which is predicted by three independent constructs: food availability, food access, and food utilization. The R^2 value for the stunting severity construct was 0.287, indicating that the three household food security constructs together explain 28.7% of the variability in the severity of the nutritional status of stunted children[12].

Although this R^2 value is moderate-low, it can still be regarded as adequate within the context of exploratory research involving vulnerable populations and complex social phenomena. Hair et al. (2020) argue that in social studies with multidimensional variables and uncontrolled environmental factors, an R^2 value of 0.20–0.30 is sufficient to support the significance of the model[22].

F. Path Coefficients and Significance

The results of the path estimation show a varying causal relationship between independent constructs to stunting severity:

TABLE 2
 DIRECT LINE COEFFICIENT

Path Relationships	Line Coefficient (β)	T-Statistics	p-value	Significant
Availability → Severity of Stunting	-0,128	1,576	0,116	Not
Access → Severity of Stunting	-0,314	3,007	0,003	Yes
Utilization→ Severity of Stunting	-0,278	2,481	0,014	Yes

These findings provide empirical evidence that not all dimensions of household food security contribute equally to the severity of stunting. Only two of the three main pillars of food security demonstrate a significant direct influence.

First, food access shows a significant negative influence on stunting severity ($\beta = -0.314$, $p < 0.01$). This confirms that the better the ability of households to obtain food—both in terms of economy, physical availability, and supply sustainability—the lower the severity of stunting experienced by children. This interpretation highlights the central role of accessibility as a

prerequisite for consistently and regularly fulfilling nutritional needs. In other words, the absence of barriers to obtaining food allows households to provide nutritious food more regularly, thereby supporting optimal child growth and reducing the risk of severe nutritional deficits[23].

Second, food utilization also shows a significant negative influence on the severity of stunting ($\beta = -0.278, p < 0.05$). These findings suggest that the quality and method of food preparation and consumption, including dietary diversity, feeding practices, and maternal knowledge of nutrition, significantly affect the severity of growth disorders [24]. By optimizing food utilization, the child's body can more efficiently absorb and utilize available nutrients, thereby reducing the likelihood of severe stunting. This aspect also often intersects with other factors such as sanitation, environmental health, and household hygiene practices[25].

In contrast, food availability did not show a statistically significant relationship with stunting severity ($\beta = -0.128, p > 0.05$). This suggests that the physical presence of food in the household—whether from self-production or purchase—does not necessarily have a direct impact on improving children's nutritional status unless it is accompanied by adequate access

and appropriate consumption practices. In this context, the available food may lack sufficient nutritional value, fail to meet children's dietary needs, or be consumed with inadequacy frequency. These findings also open up a space for discussion about the role of the "availability" dimension as a foundation that must be complemented by interventions targeting more functional dimensions, namely, access and utilization[26].

Overall, this model highlights that efforts to improve children's nutritional status, particularly in reducing the severity of stunting, necessitate a comprehensive food security strategy that extends beyond mere supply fulfilment. This strategy must also include enhancing economic accessibility and nutrition education that encourages optimal food utilization. Sectoral approaches that focus only on food productivity without considering aspects of distribution and consumption behavior are likely not effective enough in addressing the problem of severe stunting[14].

G. The Mediating Effect of Food Access

Indirect effects testing revealed that food access mediates the effect of food availability and utilization on stunting severity:

TABLE 3
 MEDIATION EFFECT

Mediation Pathway	Indirect Effect	T-Statistics	p-value	Significant
Availability → Access → Severity of Stunting	-0,092	2,144	0,032	Yes
Utilization → Access → Severity of Stunting	-0,073	2,006	0,045	Yes

These findings provide strong evidence that food access functions as a significant mediator in the causal pathway linking food availability and utilization to the severity of stunted growth. The statistically significant mediating effect observed in both pathways indicates that neither the availability nor the utilization of food does not directly and automatically improves children's nutritional status, unless households also have adequate access to food [27].

In the path of availability → access → stunting severity, a significant negative mediating effect ($\beta = -0.092, p < 0.05$) indicates that food stocks available in the environment or at the households are not necessarily effective in reducing the severity of stunting if the household encounters barriers to directly obtaining food. These barriers can take the form of limited purchasing power, inadequate market infrastructure, unequal food distribution, or socio-cultural constraints that influence decision-making patterns in food purchase and consumption. In this context, the existence of food without adequate access is functionally passive and does not guarantee the consistent fulfillment of children's daily nutritional needs[13].

Meanwhile, in the path of utilization → access → severity of stunting, similar results ($\beta = -0.073, p < 0.05$) indicate that healthy food consumption practices and good nutritional

knowledge are insufficient to reduce the severity of stunting if not supported by adequate economic and physical access to food[28]. For example, even if mothers have an adequate understanding of the importance of dietary diversity or proper feeding patterns, their ability to implement such practices depends heavily on the availability and affordability of nutritious food. In many cases, low household income, high food prices, and limited access to traditional or modern markets serve as limiting factors[29].

Thus, the interpretation of these results reinforces the understanding that food access is a critical node linking the structural (availability) and functional (utilization) dimensions of household food security. The effectiveness of interventions to reduce the severity of stunting cannot rely solely on increasing food production or improving education. It must also consider how access to food can be expanded, facilitated, and ensured for vulnerable households[30]. This underscores the importance of a systemic approach to strengthening food security, in which socio-economic policies, food distribution logistics, and the development of local market networks serve as integral components of an effective stunting reduction strategy.

H. *Statistical and Substance Implications*

These findings confirm that food access is the most critical factor in reducing the severity of stunting, both as a direct predictor and as a mediator that links the influence of food availability and utilization. Statistically, access was found to have the most significant contribution to the model, while conceptually reinforcing the understanding that food security is multidimensional and inseparable from the socio-economic context of households[6]. The key implication is that nutrition interventions focusing solely on increasing food production or consumption education will not be effective without improved access, which encompasses economic affordability, physical availability, and the sustainability of the food supply[31]. Therefore, stunting control strategies should prioritize an integrated approach that connects the three pillars of food security synergistically, with a primary focus on strengthening access as a prerequisite for effective child nutrition interventions.

I. *Analysis of Key Findings*

The results of the structural model estimation reveal that the three pillars of food security—food availability, access, and utilization—contribute differently to explaining the variation in stunting severity among children under five years old. Food access emerges as the most significant determinant, both as direct predictor of stunting severity and as a mediator between food availability and utilization. Meanwhile, food availability does not exhibit a significant direct effect, but plays a role indirectly through its influence on access[32]. These findings reflect the non-linear and multi-layered causal structures of household food security systems, which necessitate a holistic analytical approach. This complexity confirms that efforts to combat stunting cannot be reduced to a single intervention focus, but instead require cross-dimensional integration of food security strategy to produce effective and sustainable improvements in children's nutritional status[33].

J. *The Most Influential Pillars of Food Security*

The findings of this study confirm that, among the three dimensions of food security—availability, access, and utilization—food access is the most significant and dominant factor in reducing the severity of stunting among children under five. The pathway coefficient of $\beta = -0.314$ ($p = 0.003$) indicates that any increase food access, either economically (e.g. increased household income or reduction in the proportion of expenditure on food) or physically (e.g. ease of market access, transportation infrastructure), substantially contributes to a reduction in stunting severity. These significant negative effects also indicate that improved access serves as a strategic entry point for food security-based nutrition interventions[8].

The strength of food access's influence reinforces the theoretical framework proposed by FAO (2008) within the framework of the Food Security Pillars, which places access as a key determinant of effective food security. In the context of households, the mere existence of food (availability) or even the consumption of nutritious food (utilization) will not have an

optimal impact if access to food remains limited. Families with constrained resources can experience nutritional deficiencies even when food is readily available, due to insufficient purchasing power or physical barriers to food access. Therefore, an access-based approach should be prioritized in the design of stunting policies and programs that address the root of structural inequalities in the household food system [30].

K. *Comparison of Effects Between Pillars*

The comparison of effects between the three pillars of food security revealed distinct influences on stunting severity. Among them, food access demonstrated the strongest and most significant effect, with a path coefficient of $\beta = -0.314$. This indicates that the ability of households to obtain food affordably and physically plays a critical role in reducing the severity of stunting. Food utilization, which reflects the adequacy of energy and nutrient intake, also showed a significant effect ($\beta = -0.278$; $p = 0.014$), although its influence was slightly weaker than that of food access.

In contrast, food availability exhibited a weaker and statistically insignificant negative effect ($\beta = -0.128$; $p = 0.116$), suggesting that the mere physical presence of food in the household does not automatically lead to improvements in children's nutritional status. These findings imply that intervention priorities should not be limited to increasing food production or supply (the upstream aspect), but must also focus on enhancing food accessibility and promoting proper food utilization within households.

Thus, intervention priorities must be directed not only at food production or supply (the upstream aspect), but also at strengthening food accessibility (the intermediate aspect) and utilization based on actual consumption (the downstream aspect).

L. *Explanation of Causal Relationship Patterns Based on Theory*

The causal relationship patterns identified in this study support the Multidimensional Food Security Framework approach, while also strengthening recent theoretical developments regarding the dynamics of food security and children's nutritional status. Stunting severity appears to be the outcome of a complex and interconnected household food security system, covering three main dimensions: the supply-side (food availability), which describes the capacity of food production and distribution in macro and micro; the access-side, which connects economic and physical resources with the ability to obtain food; and the utilization-side, which reflects the ability of individuals or households to process, absorb, and utilize food into a healthy nutritional status[34].

The findings that food access mediates the relationship between availability and utilization suggest that access functions as a critical node within the food security system, having a direct impact on the severity of stunting[35]. Inadequate access may prevent available food from being utilized optimally. Even in the context of households with sufficient food availability, limited

purchasing power, geographical distance, or social constraints can hinder the sustainable consumption of nutritious food. These results are consistent with the current literature, which emphasises the importance of economic, spatial, and social aspects in bridging food production and nutritional outcomes[36].

Furthermore, the identified causal patterns strengthen the argument that interventions against stunting must be cross-sectoral, focusing not only on the food production or distribution side but also on household economic empowerment, nutrition education, strengthened health services, and improvements in sanitation and childcare[37]. Contemporary studies also emphasize that food security is not merely about calorie availability, but rather about access to quality food and the capacity of households to choose and utilize food effectively.

Therefore, a multidimensional and household-based approach is crucial in explaining and addressing the severity of stunting, particularly in agrarian areas characterized by high socioeconomic vulnerability[38].

M. Implications for Theory and Practice

The results of this study make a significant contribution to strengthening food security theory in relation to the nutritional status of children, particularly within the context of households in agrarian areas. Theoretically, this study confirms and expands the conceptual framework of food security as a key determinant of nutritional status, emphasizing that the relationship is indirect and mediated by several structural factors, particularly access to food[39].

First, these findings confirm that food security cannot be understood solely through a linear focus on food availability. Although availability is often the focus of many policy interventions, the results of this study show that access to food—whether in the form of purchasing power, geographical proximity, or nutrition education—plays a more significant role in reducing the severity of stunting[9].

Second, this study contributes to the existing literature by focusing on nutritional severity, rather than solely on the prevalence of stunting. To date, many studies have limited their analysis to stunting measurement as a dichotomous status (stunted vs. not stunted), despite quantitative approaches to nutritional severity being able to describe the impact of food vulnerability more precisely and being relevant to risk-based intervention design.

Third, a multidimensional approach to measuring food security (combining aspects of availability, access, and utilization) has proven more relevant in explaining the determinants of children's nutritional status. This reinforces the relevance of the FAO and UNICEF frameworks for food security and nutrition framework, and underscores the importance of integrating structural and behavioural perspectives in community nutrition research[40].

N. Practical Implications

Practically, the results of this study provide strategic direction for more targeted nutrition interventions and policy design, especially in agrarian areas such as Jember Regency, which face the paradox of high food security coexisting with a persistently high prevalence of stunting.

First, household-based interventions should prioritize improving food access as the most critical determinant. This includes programs to strengthen the purchasing power of low-income families (through social security or food subsidies), increase the nutritional literacy of homemakers, and develop food distribution infrastructure that enables families to consistently access nutritious food[26].

Second, these findings can serve as a foundation for regional policy design that is more responsive to access inequality and consumption patterns. In the context of Jember as a productive agricultural area, local governments must recognize that high food production does not necessarily translate into improved nutritional status among children. Therefore, it is necessary to mainstream food equity in regional development planning[25].

Third, the implementation of cross-sectoral programs is an absolute requirement in tackling the root causes of stunting severity, as a sectoral approach alone is no longer adequate. Synergy is needed among various sectors, including the agricultural sector to ensure the sustainability of nutritious local food supply, the health and nutrition sector to strengthen educational services and monitor children's nutritional status, and the education sector, particularly in enhancing maternal nutrition literacy through family-based curricula or community-based education initiatives.

With this integration, interventions become more responsive to the social realities of households, rather than relying solely on aggregate production or consumption data [41].

O. Research Limitations

This study makes an important contribution to the understanding of food security and children's nutritional status; however, several limitations should be acknowledged to ensure a proportional interpretation of the results.

P. Design and Data Limitations

Cross-sectional design limits the ability to draw long-term causal inferences. Additionally, the use of self-reported data on variables such as household income and maternal nutrition knowledge is subject to perception bias and potential inaccuracies in reporting.

Q. Limitations of Generalization

This study was conducted in the Jember Regency area; therefore, generalisations to other geographical and socio-economic contexts should be made with caution. Replication in other regions will reinforce the external validity of the findings.

R. Methodological Limitations

The SEM-PLS approach, although suitable for exploratory modeling, has limitations in detecting small effect sizes, particularly in models with moderate R^2 values. Additionally, other important variables, such as sanitation, parenting practices, and infectious diseases, were not included in the model, although they may significantly influence a child's nutritional status.

S. Further Research Direction

Further research is recommended using a longitudinal design to capture the dynamics of food security over time, as well as to extend the model by incorporating intermediate variables such as eating behavior, quality of consumption patterns, and children's health status, to enable a more comprehensive analysis.

IV. CONCLUSION

This study confirms that household food security is a significant determinant in explaining the severity of stunting in children, with food access identified as the most influential pillar. While food availability did not exhibit a significant direct effect, the dimensions of food access and utilization demonstrated a strong negative association with nutritional severity, either directly or through mediation.

These findings broaden the theoretical understanding of the relationship between food security and children's nutritional status by emphasizing the need for a multidimensional approach and the interdependence of food security pillars. Methodologically, the study also underscores the importance of incorporating the severity dimensions – not merely prevalence – in assessing nutritional problems as a foundation for more precise and targeted interventions.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Jember Regency Health Office for providing secondary data and logistical support during fieldwork. Special thanks are extended to the enumerators and participating households for their valuable contributions. This research was ethically approved by the Health Research Ethics Committee, Faculty of Public Health, University of Jember (No. 237/KEPK/FKM-UNEJ/VIII/2022). The study was conducted independently and did not receive any external funding or sponsorship.

CONFLICT OF INTEREST

The Authors declare no conflict of interest to disclose.

USE OF ARTIFICIAL INTELLIGENCE (AI) TOOLS STATEMENT

We used Grammarly (Grammarly Inc., 2025) to improve the clarity and grammar of the manuscript. The authors reviewed and approved all changes.

REFERENCES

- [1] Willya Achmad et al., "Malnutrition, Parenting, Poverty: Construction and Stunting Phenomena in Indonesia," *Russ. Law J.*, vol. 11, no. 2s, pp. 101–107, 2023, doi:10.52783/rlj.v11i2s.565.
- [2] G. Gusriani, N. I. Noviyanti, W. Wahida, R. Ruqaiyah, and M. Octamelia, "Determinants of Stunting in Toddlers: A Review of the Literature," *J. Health. Pomegranate Pelamonia*, vol. 7, no. 1, pp. 25–33, 2023, doi: 10.37337/jkdp.v7i1.354.
- [3] T. Huriyah and N. Nurjannah, "Risk factors of stunting in developing countries: A scoping review," *Open Access Maced. J. Med. Sci.*, vol. 8, no. F, pp. 155–160, 2020, doi: 10.3889/oamjms.2020.4466.
- [4] Hamdani, Decy Erni Nasution, Nurlaili, Mustafa, and Muhammad Ikhwan, "The Analysis of Risk Factors in Toddlers on The Occurrence of Stunting In Pidie," *South East. Eur. J. Public Heal.*, pp. 1048–1056, 2024, doi: 10.70135/seejph.vi.1437.
- [5] P. Source, A. I. R. Bersih, D. A. N. Pola, and A. Against, "INTERVENING," vol. 39, no. 1, pp. 1–5, 2012.
- [6] D. Stanberry and L. Fletcher-Paul, "The State of Food Security in the Caribbean," vol. 07, no. 07, pp. 79–92, 2024, doi: 10.1007/978-3-031-66055-9_3.
- [7] N. Resource, "Tropentag 2012, Göttingen, Germany September 19-21, 2012," 2012.
- [8] W. Kerr, "The three pillars of food security - availability, adequate income and increasing productivity," *Food Secur.*, pp. 1–12, 2023, doi: 10.4337/9781035312719.00006.
- [9] A. Muche, L. D. Gezie, A. G. egzabher Baraki, and E. T. Amsalu, "Predictors of stunting among children age 6–59 months in Ethiopia using Bayesian multi-level analysis," *Sci. Rep.*, vol. 11, no. 1, pp. 1–12, 2021, doi:10.1038/s41598-021-82755-7.
- [10] P. H. P. Remium and H. A. D. Evice, "S Pecifications F or T He," p. 9, 2009.
- [11] C. Handzel, "Food Insecurity : United States," 2018.
- [12] E. But et al., "Socio-demographic and environmental determinants of under-stunting in Rwanda: Evidence from a multisectoral study," *Front. Public Heal.*, pp. 1–13, 2023.
- [13] D. Haile, M. Azage, T. Mola, and R. Rainey, "Exploring spatial variations and factors associated with childhood stunting in Ethiopia: Spatial and multilevel analysis," *BMC Pediatr.*, vol. 16, no. 1, pp. 1–14, 2016, doi:10.1186/s12887-016-0587-9.
- [14] S. Psaki et al., "Household Food Access and Child Malnutrition: Results from the Eight- Country MAL-ED Study," *Food Secur. Child Malnutrition Impact Heal. Growth, Well-Being*, pp. 73–89, 2016.
- [15] L. Serra-Majem, "Food availability and consumption at national, household and individual levels: implications

- for food-based dietary guidelines development,” *Public Health Nutr.*, vol. 4, no. 2b, pp. 673–676, 2001, doi: 10.1079/phn2001152.
- [16] B. J. Akombi, K. E. Agho, J. J. Hall, D. Merom, T. Astell-Burt, and A. M. N. Renzaho, “Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis,” *BMC Pediatr.*, Vol. 17, No. 1, 2017, doi: 10.1186/S12887-016-0770-Z.
- [17] X. Wang, B. Höjer, S. Guo, S. Luo, W. Zhou, and Y. Wang, “Stunting and ‘overweight’ in the WHO Child Growth Standards -malnutrition among children in a poor area of China,” *Public Health Nutr.*, vol. 12, no. 11, pp. 1991–1998, 2009, doi: 10.1017/S1368980009990796.
- [18] D. Russo and K. J. Stol, “PLS-SEM for software engineering research: An introduction and survey,” *ACM Comput. Surv.*, vol. 54, no. 4, 2022, doi: 10.1145/3447580.
- [19] G. W. Cheung, H. D. Cooper-Thomas, R. S. Lau, and L. C. Wang, *Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations*, vol. 41, no. 2. Springer US, 2024. doi: 10.1007/s10490-023-09871-y.
- [20] M. Salehi, “The Construct Validity of a Test: A Triangulation of Approaches,” *Lang. Test. Asia*, vol. 2, no. 2, pp. 102–119, 2012, doi: 10.1186/2229-0443-2-2-102.
- [21] K. Bannigan and R. Watson, “Reliability and validity in a nutshell,” *J. Clin. Only.*, vol. 18, no. 23, pp. 3237–3243, 2009, doi: 10.1111/j.1365–2702.2009.02939.x.
- [22] K. E. Agho *et al.*, “Moderate and severe household food insecurity predicts stunting and severe stunting among Rwanda children aged 6–59 months residing in Gicumbi district,” *Matern. Child Nutr.*, vol. 15, no. 3, pp. 1–10, 2019, doi: 10.1111/mcn.12767.
- [23] M. De Onis, M. Blössner, and E. Borghi, “Prevalence and trends of stunting among pre-school children, 1990–2020,” *Public Health Nutr.*, vol. 15, no. 1, pp. 142–148, 2012, doi: 10.1017/S1368980011001315.
- [24] N. K. Sari and A. Pramono, “of Nutrition College , Volume Halaman of Nutrition College , Volume Halaman,” *J. Nutr. Coll.*, vol. 4, pp. 428–434, 2015.
- [25] B. A. Omachi, A. Van Onselen, and U. Kolanisi, “The Household Food Security and Feeding Pattern of Preschool Children in North-Central Nigeria,” *Nutrients*, vol. 14, no. 19, 2022, doi: 10.3390/nu14194112.
- [26] V. Nsabuwera *et al.*, “Making progress towards food security: Evidence from an intervention in three rural districts of Rwanda,” *Public Health Nutr.*, vol. 19, no. 7, pp. 1296–1304, 2016, doi: 10.1017/S1368980015002207.
- [27] S. Kureishy *et al.*, “A mixed methods study to assess the effectiveness of food-based interventions to prevent stunting among children under-five years in Districts Thatta and Sujawal, Sindh Province, Pakistan: Study protocol,” *BMC Public Health*, vol. 17, no. 1, pp. 1–6, 2017, doi: 10.1186/s12889-016-3976-y.
- [28] D. Ayuningtyas, D. Hapsari, R. Rachmalina, V. Amir, R. Rachmawati, and D. Kusuma, “Geographic and Socioeconomic Disparity in Child Undernutrition across 514 Districts in Indonesia,” *Nutrients*, vol. 14, no. 4, pp. 1–17, 2022, doi: 10.3390/nu14040843.
- [29] R. Lehto *et al.*, “Effects of the DAGIS randomized controlled trial on home environment and children’s food consumption according to the degree of implementation,” *BMC Public Health*, vol. 22, no. 1, pp. 1–15, 2022, doi: 10.1186/s12889-022-14639-y.
- [30] D. D. Weatherspoon, S. Miller, J. C. Ngabitsinze, L. J. Weatherspoon, and J. F. Oehmke, “Stunting, food security, markets and food policy in Rwanda,” *BMC Public Health*, vol. 19, no. 1, pp. 1–13, 2019, doi: 10.1186/s12889-019-7208-0.
- [31] H. Y. Lee, I. H. Song, and I. Kawachi, “Maternal and child social support and food availability in relation to child growth in four low- and middle-income countries,” *Sci. Rep.*, vol. 12, no. 1, pp. 1–10, 2022, doi: 10.1038/s41598-022-09850-1.
- [32] R. Avula *et al.*, “Reducing childhood stunting in India: Insights from four subnational success cases,” *Food Secur.*, vol. 14, no. 4, pp. 1085–1097, 2022, doi: 10.1007/s12571-021-01252-x.
- [33] P. Modjadji and S. Madiba, “The Multidimension of Malnutrition among School Children in a Rural Area, South Africa: A Mixed Methods Approach,” *Nutrients*, vol. 14, no. 23, pp. 1–14, 2022, doi: 10.3390/nu14235015.
- [34] C. M. Harvey, M. L. Newell, and S. Padmadas, “Maternal socioeconomic status and infant feeding practices underlying pathways to child stunting in Cambodia: structural path analysis using cross-sectional population data,” *BMJ Open*, vol. 12, no. 11, pp. 1–9, 2022, doi: 10.1136/bmjopen-2021-055853.
- [35] M. S. Islam, A. N. Zafar Ullah, S. Mainali, M. A. Imam, and M. I. Hasan, “Determinants of stunting during the first 1,000 days of life in Bangladesh: A review,” *Food Sci. Nutr.*, vol. 8, no. 9, pp. 4685–4695, 2020, doi: 10.1002/fsn3.1795.
- [36] A. Harper, Chirwa Esnat, A. Rothberg, W. Sambu, S. Mall, and J. Goudge, “Dietary diversity, food insecurity and the double burden of malnutrition among children, adolescents and adults in South Africa: Findings from a national survey,” *Front. Public Heal.*, vol. 10, 2022.
- [37] G. Dessie, G. W. Tsegaye, B. A. Mekonnen, M. T. Bayih, and Z. M. Nigussie, “Change in stunting and its associated factors among children aged less than 5 years in Ethiopia using Ethiopia Demographic and Health Survey data from 2005 to 2019: a multivariate decomposition analysis,” *BMJ Open*, vol. 12, no. 11, 2022, doi: 10.1136/bmjopen-2022-061707.

- [38] E. Kristjansson *et al.*, “months to five years (Review),” 2015, doi: 10.1002/14651858.CD009924.pub2.www.cochranelibrary.com.
- [39] E. Duncan *et al.*, “Connecting the food and agriculture sector to nutrition interventions for improved health outcomes,” *Food Secur.*, vol. 14, no. 3, pp. 657–675, 2022, doi: 10.1007/s12571-022-01262-3.
- [40] I. Schedule *et al.*, *No Covariance Structure Analysis of Health-Related Indicators in Elderly People Living at Home with a Focus on Subjective Health Perception* Title, vol. 2, no. 1. 2022. [Online]. Available: <http://www.ifpri.org/themes/gssp/gssp.htm>
- [41] J. Tendeukai Kunashe Nondo, “Review of the Food and Agriculture Organisation (FAO) Strategic Priorities on Food Safety 2023,” 2023, doi: 10.5772/intechopen.112132.