

The Effect of Special Allocation Funds on Human Development Index with Stunting Prevalence as a Mediating Variable: An Empirical Study on Districts/Cities in Sulawesi Region (2021–2024)

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Abstract. *This study examines the effect of Physical Special Allocation Funds (DAK Fisik) and Non-Physical Special Allocation Funds (DAK Non Fisik) on the Human Development Index (HDI), with stunting prevalence as a mediating variable. Using balanced panel data from 81 districts/cities in Sulawesi during 2021–2024 (324 observations), the analysis employs Fixed Effect Model panel regression and Sobel Test. The results show that DAK Non Fisik significantly reduces stunting prevalence (coefficient = -4.460, $p = 0.007$) and significantly improves HDI (coefficient = 3.278, $p = 0.000$), while DAK Fisik shows no significant effect on either variable. Stunting prevalence significantly reduces HDI (coefficient = -0.059, $p = 0.044$), but does not mediate the relationship between DAK and HDI. These findings highlight the importance of strengthening operational service funding as a more immediate instrument for improving human development outcomes in regions with persistent stunting challenges.*

Keywords: Special Allocation Fund, Human Development Index, Stunting, Fiscal Decentralization, Mediation Analysis

INTRODUCTION

The Indonesian government has committed to enhancing human development through the National Medium-Term Development Plan (RPJMN) 2020–2024, with a target Human Development Index (HDI) of 75.54 by 2024. However, the national achievement in 2024 reached only 75.02, with substantial regional disparities. The Sulawesi region recorded an average HDI of 72.26, well below the national figure, while its stunting prevalence reached 25.92%, significantly higher than the national average of 19.8% (BPS, 2024; Kementerian Kesehatan, 2025). These disparities indicate that human development outcomes are uneven across regions, particularly in Eastern Indonesia where regional fiscal capacity remains limited.

To address these challenges, the central government allocates Special Allocation Funds (DAK) to regional governments as an earmarked fiscal transfer designed to support national priority programs. DAK consists of two main categories: DAK Fisik, which funds infrastructure development for basic public services such as health, education, and sanitation facilities; and DAK Non Fisik, which finances operational activities including the School Operational Assistance (BOS), Health Operational Assistance (BOK), Family Planning Operational Assistance (BOKB), and teacher allowances. Both types are intended to strengthen the capacity of regional governments in delivering basic public services that contribute to human development.

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Previous studies on the effect of DAK on human development have produced inconsistent findings. Studies by Ina & Hudang (2024) and Pidhegso et al. (2025) reported a significant positive effect of DAK on HDI, while Hasan & Agung (2018) and Sulastri & Efendri (2021) found no significant or even negative effects. Studies examining the relationship between DAK and stunting are similarly inconclusive (Damayanti, 2023; Hamzah et al., 2025; Kurniasih, 2023). Although the literature consistently demonstrates that stunting affects human capital formation and consequently HDI (Jaya et al., 2022; Oktavia, 2021; Riadi et al., 2025), no empirical study has explicitly examined stunting prevalence as a mediating variable in the relationship between DAK and HDI.

This research addresses this gap by examining whether stunting prevalence mediates the relationship between DAK Fisik, DAK Non Fisik and HDI in districts/cities across the Sulawesi region during the 2021–2024. The study contributes to the literature in three ways. First, it positions stunting prevalence as a novel mediating variable in the fiscal transfer–human development nexus. Second, it differentiates between DAK Fisik and DAK Non Fisik to identify distinct transmission mechanisms. Third, it focuses on the Sulawesi region, which remains underrepresented in empirical studies despite facing persistent human development challenges.

LITERATURE REVIEW

Fiscal Decentralization Theory

The theoretical foundation of this study is the fiscal decentralization theory proposed by Oates. The Decentralization Theorem posits that the delegation of fiscal authority to regional governments results in more efficient allocation of public resources, as regional governments possess superior information regarding the preferences and needs of their local populations. However, this efficiency can only be realized when fiscal capacity is relatively equal across regions. Disparities in fiscal capacity provide the theoretical justification for earmarked fiscal transfers from the central government to subnational governments, ensuring the achievement of minimum public service standards (Oates, 2011).

Indonesian government uses DAK as an earmarked transfer instrument designed to address fiscal disparities while ensuring the delivery of basic public services in priority sectors such as health and education, which directly influence the quality of human resources and HDI.

Human Development Index (HDI)

HDI is a composite index that measures human development achievements across three dimensions: health (life expectancy at birth), education (expected years of schooling and mean years of schooling), and standard of living (per capita expenditure). Since 2014, Statistics Indonesia (BPS) has calculated HDI using a geometric mean of these three-dimension indices (BPS, 2024). HDI represents the ultimate outcome of human development policies and reflects the cumulative impact of various interventions, including fiscal transfers, on population welfare.

Stunting

Stunting is a condition of impaired growth in children under five years of age caused by chronic malnutrition, characterized by height-for-age z-scores more than two standard deviations below the WHO Child Growth Standards median (WHO, 2025). Beyond being a health indicator, stunting reflects multidimensional household conditions including access to sanitation, maternal education, household purchasing power, and the quality of health services in a given region.

The critical period for stunting prevention is the First 1,000 Days of Life (1,000 HPK), from conception through the child's second birthday, during which nutritional and health interventions most decisively shape brain and physical development. Damage caused by chronic malnutrition during this period is largely irreversible and produces long-term consequences including reduced cognitive capacity, lower educational attainment, decreased adult productivity, and increased risk of chronic diseases (Hoddinott et al., 2013).

Special Allocation Funds (DAK)

Based on Law No. 1 of 2022 on Financial Relations between the Central Government and Regional Governments, DAK is an earmarked transfer from the state budget allocated to regional governments to

fund priority national programs. DAK operates through two distinct mechanisms. DAK Fisik finances the development of infrastructure and physical facilities for basic public services, while DAK Non Fisik finances the operational activities required to deliver these services, including the School Operational Assistance (BOS), Health Operational Assistance (BOK), and teacher allowances (Kementerian Keuangan, 2024).

Mediation Framework and Hypothesis Development

According to Hayes & Little (2022), a mediating variable functions to explain the process or mechanism through which an independent variable affects a dependent variable via an intermediary pathway. In this study, stunting prevalence is positioned as a mediating variable connecting the effect of DAK on HDI. The selection of stunting as a mediator is grounded in its multidimensional nature: stunting reflects the cumulative effect of basic service quality, household socioeconomic conditions, and public health interventions, all of which can be influenced by fiscal transfers.

Based on the theoretical framework and previous empirical findings, this study formulates the following hypotheses:

- H₁: DAK Fisik has a significant negative effect on stunting prevalence.
- H₂: DAK Non Fisik has a significant negative effect on stunting prevalence.
- H₃: DAK Fisik has a significant positive effect on HDI.
- H₄: DAK Non Fisik has a significant positive effect on HDI.
- H₅: Stunting prevalence has a significant negative effect on HDI.
- H₆: Stunting prevalence mediates the effect of DAK Fisik on HDI.
- H₇: Stunting prevalence mediates the effect of DAK Non Fisik on HDI.

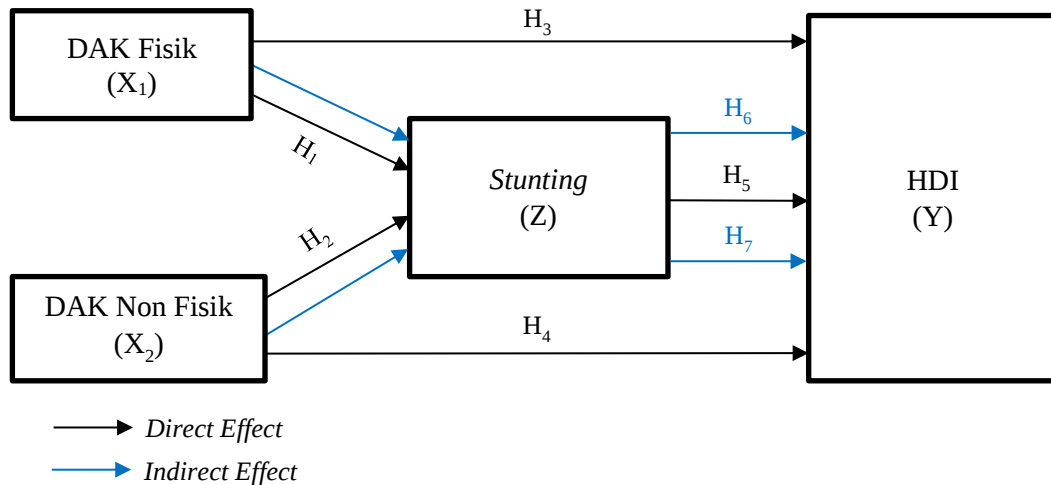


FIGURE 1. Conceptual Framework

METHODS

This study employs a quantitative associative design analyzing the effect of DAK Fisik and DAK Non Fisik on HDI with stunting prevalence as a mediating variable. The unit of analysis comprises 81 districts and cities in the Sulawesi region observed during 2021–2024, producing a balanced panel of 324 observations through saturated sampling. Secondary data were obtained from Statistics Indonesia (HDI), the Directorate General of Fiscal Balance (DAK realization), and the Ministry of Health (stunting prevalence, SSGI 2021–2022 and SKI 2023–2024). The DAK variables were transformed using natural logarithm to address the wide range of values across districts.

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The analytical framework consists of two substructures. Sub Structure 1 examines the effect of DAK Fisik and DAK Non Fisik on stunting prevalence:

$$Z = \alpha_1 + \beta_1 DAKFit + \beta_2 DAKNFit + \varepsilon_1$$

Sub Structure 2 examines the effect of DAK Fisik, DAK Non Fisik, and stunting prevalence on HDI:

$$Y = \alpha_2 + \beta_3 DAKFit + \beta_4 DAKNFit + \beta_5 STUNTINGit + \varepsilon_2$$

The panel data analysis follows a sequential procedure: model selection through Chow, Hausman, and Lagrange Multiplier tests; classical assumption tests; multiple linear regression; and hypothesis testing using t-test and coefficient of determination. The mediation effect is tested using the Sobel Test, where mediation is considered significant when $|z| > 1.96$ or $p < 0.05$. Data processing was conducted using EVIEWS 13.

RESULTS AND DISCUSSION

Model Selection and Classical Assumption Tests

The model selection tests (Chow, Hausman, and Lagrange Multiplier) consistently indicated that the Fixed Effect Model (FEM) is the most appropriate specification for both substructures. All classical assumption tests were satisfied. The Adjusted R^2 values of 53.99% and 80.42% for Sub-Structure 1 and Sub-Structure 2 respectively indicate adequate explanatory power of the models.

Hypothesis Testing Results

The results of hypothesis testing across both substructures are summarized in Table 1.

TABLE 1. Summary of Hypothesis Testing Results

H	Relationship	Coefficient	Prob.	Result
H ₁	DAK Fisik → Stunting	+0.310	0.673	Not Significant
H ₂	DAK Non Fisik → Stunting	-4.460	0.007	Significantly Negative
H ₃	DAK Fisik → HDI	-0.586	0.081	Not Significant
H ₄	DAK Non Fisik → HDI	+3.278	0.000	Significantly Positive
H ₅	Stunting → HDI	-0.059	0.044	Significantly Negative
H ₆	DAK Fisik → Stunting → HDI	—	0.679	Mediation Not Supported
H ₇	DAK Non Fisik → Stunting → HDI	—	0.104	Mediation Not Supported

Effect of DAK Fisik on Stunting Prevalence (H₁)

The results indicate that DAK Fisik does not significantly affect stunting prevalence ($\beta = +0.310$, $p = 0.673$), thus H₁ is rejected. The positive coefficient does not imply that DAK Fisik increases stunting; rather, it likely reflects reverse causality, as regions with higher stunting burdens tend to receive larger DAK Fisik allocations as a corrective policy response.

From a fiscal decentralization perspective, the effectiveness of fiscal transfers depends not only on the magnitude of allocation but also on regional capacity to translate spending into utilized services. As DAK Fisik primarily serves as an input to development by providing infrastructure for basic services, and given the multidimensional nature of stunting that is influenced by nutrition, parenting practices, maternal education, sanitation, and household economic conditions, physical infrastructure alone is insufficient to drive stunting reduction without complementary operational programs.

These findings align with Kurniasih (2023) but differ from Damayanti (2023) and Hamzah et al. (2025), suggesting that the effectiveness of DAK Fisik is highly context-dependent.

Effect of DAK Non Fisik on Stunting Prevalence (H₂)

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The results show that DAK Non Fisik has a significant negative effect on stunting prevalence ($\beta = -4.460$, $p = 0.007$), confirming H_2 . This finding indicates that operational spending has a more direct association with stunting reduction compared to physical infrastructure spending.

This relationship can be understood through the three main components of DAK Non Fisik that are directly relevant to stunting prevention. The Health Operational Assistance (BOK) finances promotive and preventive health activities at the primary care level, including growth monitoring, nutrition improvement, maternal and child health services, and posyandu activation as the frontline for stunting detection. The Family Planning Operational Assistance (BOKB) supports family planning programs that contribute to fertility control and improved parenting quality. The Early Childhood Education Operational Assistance (BOP PAUD) ensures the continuity of early childhood education services that stimulate child development during the critical 1,000 HPK period. These three components work synergistically during the most critical phase for stunting prevention.

Furthermore, the effectiveness of DAK Non Fisik depends not only on the magnitude of allocation but also on service continuity and regional government capacity to ensure that programs reach intended beneficiaries. Strengthening cross-sectoral coordination and consistency of interventions are key factors for operational spending to produce tangible improvements in nutritional outcomes.

This finding aligns with Kurniasih (2023) and Damayanti (2023) but contrasts with Azizah (2024), suggesting that DAK Non Fisik's effectiveness remains contingent on regional governance quality and program implementation capacity.

Effect of DAK Fisik on HDI (H_3)

The results indicate that DAK Fisik does not significantly affect HDI ($\beta = -0.586$, $p = 0.081$), thus H_3 is rejected. This finding is consistent with the H_1 result, suggesting that DAK Fisik has not produced measurable direct effects on human development outcomes during the study period.

Health infrastructure built through DAK Fisik, such as health centers and sanitation facilities, affects life expectancy only when fully utilized by the population. Similarly, educational infrastructure such as classrooms and school buildings contribute to expected years of schooling only when accompanied by quality services and equitable access. The success of DAK Fisik in promoting HDI therefore depends not merely on facility availability but also on effective service delivery supported by adequate personnel and sustainable operational programs.

In several areas of Sulawesi, archipelagic geography and limited inter-regional connectivity affect the utilization of physical infrastructure. Consequently, available basic service facilities may not be equally accessible to all populations, contributing to the weak relationship between DAK Fisik realization and HDI achievement at the district/city level. The negative but insignificant coefficient again reflects the policy allocation mechanism, where regions with lower HDI tend to receive larger DAK Fisik allocations rather than indicating that DAK Fisik causes HDI decline.

These findings align with Hasan & Agung (2018) who found no significant effect of DAK on HDI, and are directionally consistent with Simanjuntak et al. (2024) and Sulastris & Efendri (2021) who reported negative effects of DAK on HDI. However, the results differ from Ina & Hudang (2024), Pidhegso et al. (2025), and Soejoto et al. (2015) who found significant positive effects. The divergence indicates that the effect of DAK Fisik on human development is highly contextual and depends on regional fiscal capacity, governance quality, and the integration between physical investment and operational service delivery.

Effect of DAK Non Fisik on HDI (H_4)

The results demonstrate that DAK Non Fisik has a significant positive effect on HDI ($\beta = 3.278$, $p = 0.000$), confirming H_4 . This finding represents the strongest empirical result in the study.

Substantively, the positive effect of DAK Non Fisik on HDI is explained by its function in maintaining the sustainability and quality of basic services. The School Operational Assistance (BOS) and teacher professional allowances contribute to improvements in expected years of schooling and mean years of schooling, while the BOK supports improvements in life expectancy through sustainable primary health care services. In districts/cities across Sulawesi that still face limited access and inequalities in public service quality, DAK Non Fisik serves as a critical instrument for ensuring that basic services effectively reach communities.

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These findings align with Ina & Hudang (2024), Pidhegso et al. (2025), and Soejoto et al. (2015), but differ from Sulastri & Efendri (2021) and Hasan & Agung (2018) who reported negative or insignificant effects. The differential effectiveness between DAK Fisik and DAK Non Fisik observed in this study provides important empirical evidence supporting the strategic prioritization of operational service funding in fiscal transfer policy.

Effect of Stunting Prevalence on HDI (H₅)

The results confirm that stunting prevalence has a significant negative effect on HDI ($\beta = -0.059$, $p = 0.044$), supporting H₅. This finding indicates that higher stunting prevalence is associated with lower HDI achievement.

Stunting, as a form of chronic malnutrition, affects children's physical and cognitive development, which is ultimately reflected in reduced achievement across HDI's health, education, and economic capacity dimensions. The impact of stunting is irreversible when it occurs during the 1,000 HPK period, making its implications for human capital quality both long-term and structural. High stunting prevalence also reflects the underlying quality of basic services and socioeconomic conditions in a region, as stunting typically correlates with limited access to healthcare, poor sanitation, inadequate parenting practices, low maternal education, and insufficient household nutrition resources.

These findings align with Jaya et al. (2022), Syahputra & Sitohang (2024), Oktaviani et al. (2024), and Riadi et al. (2025), but differ from Rahman & Wijaya (2024) who found no significant effect of stunting on HDI. The robust negative association observed in this study reinforces the view that stunting reduction should be regarded not solely as a health agenda but as a fundamental human development strategy directly tied to the enhancement of regional human resource quality.

Mediation of DAK Fisik on HDI through Stunting (H₆)

The Sobel Test results indicate that stunting prevalence does not mediate the relationship between DAK Fisik and HDI ($p = 0.679$), thus H₆ is rejected. According to Hayes & Little (2022), mediation requires that the independent variable first significantly affects the mediating variable, which then affects the dependent variable. Since DAK Fisik does not significantly affect stunting prevalence (H₁), the indirect pathway through stunting cannot be statistically established.

Substantively, the absence of mediation indicates that physical development funded by DAK Fisik has not been successfully translated into improvements in stunting that subsequently affect human development. DAK Fisik is more aligned with development outputs in the form of facility provision, while mediation through stunting requires outcome changes in the form of improved community nutritional status. Therefore, the existence of physical outputs is insufficient to form an indirect pathway to HDI unless they translate into improvements in service delivery and social conditions that affect stunting.

This result does not imply that DAK Fisik is irrelevant to human development. Rather, it suggests that DAK Fisik may influence HDI through other mechanisms such as improved access to basic services, regional connectivity, or support for social and economic activities, rather than specifically through stunting reduction in the short term. Given the limited body of empirical literature that directly tests this mediation pathway, this study provides an important initial contribution to understanding fiscal transfer transmission mechanisms toward human development.

Mediation of DAK Non Fisik on HDI through Stunting (H₇)

The Sobel Test results indicate that stunting prevalence does not mediate the relationship between DAK Non Fisik and HDI ($p = 0.104$), thus H₇ is rejected, despite DAK Non Fisik significantly affecting stunting (H₂) and stunting significantly affecting HDI (H₅).

The dominance of the direct pathway provides the primary explanation. HDI improvements associated with DAK Non Fisik occur more strongly through direct support for basic service operations, particularly through education-related components such as BOS and teacher allowances that affect HDI's education dimension directly, and BOK that supports life expectancy improvements through sustainable primary healthcare. This direct transmission is statistically more dominant than the indirect pathway through stunting reduction.

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While DAK Non Fisik effectively reduces stunting prevalence, the consequent improvements in human capital quality manifest in HDI components only over extended periods. The absence of statistical mediation in this study reflects the temporal limitations of the observation window rather than the conceptual irrelevance of the pathway.

CONCLUSIONS

This study examined the effect of DAK Fisik and DAK Non Fisik on HDI with stunting prevalence as a mediating variable in 81 districts/cities across the Sulawesi region during 2021–2024. The findings reveal that DAK Non Fisik plays a substantially more effective role than DAK Fisik in promoting human development. Specifically, DAK Non Fisik significantly reduces stunting prevalence and increases HDI, while DAK Fisik shows no significant effect on either outcome. Stunting prevalence significantly reduces HDI, confirming its role as a determinant of human development. However, stunting prevalence does not statistically mediate the relationship between either type of DAK and HDI during the study period, indicating that direct pathways, particularly through DAK Non Fisik, are more dominant in the short term.

These findings carry important policy implications. The central government should strengthen outcome-based evaluation mechanisms for DAK transfers and prioritize the allocation and effectiveness of DAK Non Fisik components, particularly BOK for nutrition-specific interventions, BOKB for family planning, and BOP PAUD for early childhood education, as these directly support stunting prevention and human development. Regional governments should optimize the utilization of DAK Non Fisik for promotive and preventive basic services while strengthening cross-sectoral coordination through regional planning agencies (Bappeda). The integration between DAK Fisik and DAK Non Fisik should be reinforced to ensure that physical infrastructure investments translate into sustained human development outcomes.

This study has several limitations. First, the use of secondary aggregate data at the district/city level limits the ability to capture actual implementation conditions in the field, including program execution quality, targeting accuracy, and service utilization by communities. Second, publicly available DAK data reflect budget realization rather than the quality of spending or its resulting outputs and outcomes, so larger allocations do not necessarily indicate equivalent program impacts across regions. Third, the considerable variation in socioeconomic characteristics, fiscal capacity, governance quality, and geographic conditions across districts and cities in Sulawesi may influence DAK effectiveness in ways not fully captured by the model. Although the study does not include traditional socioeconomic control variables such as regional GDP per capita and poverty rates, the Fixed Effect Model specification mitigates potential omitted variable bias by capturing time-invariant region-specific characteristics through district-level fixed intercepts.

Future research could extend this analysis by employing lagged panel models, for example using t-1 or t-2 lag variables, to capture the delayed effects of fiscal investments on stunting and human development outcomes, as the impact of infrastructure investments and operational programs from prior fiscal cycles may only materialize in subsequent periods.

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