



RESEARCH ARTICLE

# The Influence of Education, Minimum Wage and Human Development Index on Poverty in North Sumatra Province from 2015 to 2024

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## ABSTRACT

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This study aims to analyze the influence of education, minimum wage, and the Human Development Index (HDI) on poverty levels across 33 regencies/cities in North Sumatra Province for the 2015-2024 period. Employing a quantitative approach with panel data regression analysis, this research establishes the Fixed Effect Model (FEM) as the optimal estimation model through a series of rigorous tests. The results indicate that, simultaneously, education, minimum wage, and HDI have a significant impact on poverty, with an explanatory power of 87.15%. Partially, all three variables exert a significant negative influence, indicating that enhancing human capital quality and wage standards effectively reduces poverty rates. The policy implications of these findings emphasize the importance of an integrated poverty reduction strategy through improved educational access, wage policies that ensure purchasing power, and the strengthening of health and living standard dimensions. Local governments should prioritize budget allocation to the sectors constituting the HDI to accelerate equitable poverty reduction throughout North Sumatra.

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## Introduction

Poverty remains a fundamental issue in Indonesia's national development agenda, although long-term trends show a gradual decline in the percentage of the poor. Based on data from the Central Bureau of Statistics ((BPS) (2024), the percentage of the poor in Indonesia in March 2024 stood at 9.03%, encompassing approximately 25.22 million people. This phenomenon reflects the dynamics of post-COVID-19 economic recovery, where poverty rates experienced a significant spike during the 2020-2021 period before eventually leveling off. The primary national challenge lies in an economic structure still dominated by the informal sector and the low quality of human resources, which causes the benefits of economic growth to be distributed ineffectively across all layers of society (BPS, 2024).

At the regional level, North Sumatra Province faces complex poverty characteristics with a decline pattern relatively aligned with national trends but possessing its own vulnerabilities. The poverty percentage in this region reached over 10% in 2015 and gradually decreased to 7.99% in

March 2024 and 7.19% in September 2024, representing approximately 1.11 million people. However, data indicates a "rebound" phenomenon in March 2025 with an estimated increase to 7.36%, indicating economic instability at the local level (BPS Sumut, 2024). Stark inter-regional disparities, particularly the welfare gap between urban and rural areas dominated by low-productivity agriculture, emphasize that poverty in North Sumatra remains a crucial issue requiring structural handling.

The fundamental problem that arises is the suboptimal correlation between improved macroeconomic indicators and the decline in poverty rates across regencies/cities in North Sumatra. Although the Provincial Minimum Wage (UMP) continues to increase annually, this is not necessarily followed by the expansion of employment opportunities in the formal sector; consequently, many workers remain trapped in the informal sector with wages inadequate to escape the poverty line. Furthermore, the improvement of the Human Development Index (HDI) in this region has not been evenly distributed, where areas with limited access to education tend to have more persistent poverty levels. This condition creates the risk of a "vicious cycle of poverty," where low access to quality human capital hampers sustainable increases in productivity and community income.

Theoretically, the linkage between variables in this study is based on a strong foundation of development economics. The education variable is viewed as a crucial human capital investment for increasing productivity and income opportunities, as emphasized by Todara & Smith (2020) and Arsyad (2022). Mulyadi (2019) adds that education determines the competitiveness of labor in the job market. Regarding the minimum wage, Borjas (2023) and Ehrenberg & Smith (2021) explain that wage policy is a protective instrument to guarantee a decent standard of living, although its effectiveness depends heavily on the local labor market structure. Tambun (2021) also highlights the role of wages in driving the purchasing power of the Indonesian people. Meanwhile, HDI reflects the expansion of basic human capabilities through health, education, and a decent standard of living (Becker, 1993; Aryad, 2022). Brata (2020) emphasizes the importance of human development in a local context to reduce inequality. Furthermore, poverty is understood not merely as a lack of income but as a deprivation of capabilities that limits an individual's freedom to live decently (Banerjee & Duflo, 2019; Ravallion, 2016; Suryawati, 2021).

Several previous studies show diverse empirical results regarding the influence of these variables on poverty. Kasih & Yefriza (2025) found that although HDI and minimum wage have an influence, their impact on poverty across Sumatra as a whole still requires strengthening supporting policies. In a more specific region, Nainggolan et al. (2024) reviewed the significant influence of HDI on poverty in North Sumatra for the 2018-2023 period, while Firdaus et al. (2025) in Lampung Province found different interactions between wages and unemployment toward poverty rates. However, Nujum & Arfah (2024) in their study in South Sulawesi provided contrasting findings where education, wages, and HDI do not always have a simultaneous significant effect, indicating an suboptimal policy implementation gap between regions.

The research gap in this study lies in the need for an updated analysis covering the crucial transition period of 2015-2024, which includes the pre-, during, and post-pandemic periods in North Sumatra. The novelty of this research is a comprehensive analysis that combines education, minimum wage, and HDI variables simultaneously in one regression model to explain poverty dynamics at the provincial level with the most current data. This study does not merely focus on national trends but dissects the mechanisms causing spatial inequality in North Sumatra to discover why poverty reduction tends to be slower in certain regencies/cities compared to others.

The urgency of this research is based on the pressing need for empirical evidence for the North Sumatra Provincial Government in formulating evidence-based poverty alleviation policies. The main objective of this study is to analyze and prove, both partially and simultaneously, the influence of education, minimum wage, and HDI on poverty levels in North Sumatra. Through the results of this analysis, it is expected to provide a practical contribution in determining human development priorities and more effective wage regulation strategies to break the cycle of poverty and improve community welfare equitably in North Sumatra..

## **Method**

This study employs a quantitative approach with a causal design aimed at examining the influence of independent variables, namely Education (X1), Minimum Wage (X2), and Human Development Index (X3), on the dependent variable, Poverty (Y), across 33 regencies/cities in North Sumatra Province. According to Sugiyono (2021), a quantitative approach is appropriate for researching specific populations or samples with the objective of testing established hypotheses through statistical data analysis. The selection of this method is based on the need to precisely measure the strength of the influence between macroeconomic variables using numerical data sourced from official publications of the Central Bureau of Statistics (BPS). The research period is set from 2015 to 2024 to capture the comprehensive socio-economic dynamics in the North Sumatra region.

Data collection was conducted through the documentation of secondary data, consisting of both time-series and cross-sectional data. Data were gathered from the official portal of BPS North Sumatra Province (<https://sumut.bps.go.id>) through routine publications such as North Sumatra Province in Figures and Human Development Index reports. The processed data include the Mean Years of Schooling (Education), Regency/City Minimum Wage (Minimum Wage), and the Human Development Index (HDI) across 33 regencies/cities over ten years of observation. This data structure forms panel data (pooled data), which, according to Wooldridge (2020), offers the advantage of capturing heterogeneity in characteristics across regions and providing a greater degree of freedom, thereby yielding more efficient estimates.

Data analysis was performed using panel data regression techniques. To determine the most accurate estimation model, a series of tests were conducted, including the Chow test, Hausman test, and Lagrange Multiplier test. Before interpreting the results, the model was subjected to classical assumption tests modified for panel data, including multicollinearity and heteroscedasticity tests, to ensure the estimated parameters are Best Linear Unbiased Estimators (BLUE). Hypothesis testing was conducted partially through the t-test and simultaneously through the F-test, alongside measuring variable contributions via the Coefficient of Determination (R<sup>2</sup>). All statistical computational stages were performed using EViews or Stata software.

The panel data regression model equation used in this study is formulated as follows:

$$Y_{it} = \beta_0 + \beta_1 [X1]_{it} + \beta_2 [X2]_{it} + \beta_3 [X3]_{it} + \varepsilon_{it}$$

Keterangan:

Description:

Y<sub>it</sub> = Poverty in regency/city

X1<sub>it</sub> = Education

X2<sub>it</sub> = Minimum Wage

X3<sub>it</sub> = Human Development Index

i = Regency/city

t = Observation year

β<sub>0</sub> = Constant

β<sub>1</sub>, β<sub>2</sub>, β<sub>3</sub>, = Regression coefficients

ε<sub>it</sub> = error term.

## Results and Discussion

### Chow Test

Table 1. Chow Test

Redundan Fixed Effect Test			
Test cross-section fixed effect			
Effect tests	Statistic	d.f.	Prob.
Cross-section F	12.4582	(32.294)	0.0000
Cross-section Chi-square	245.8124	32	0.0000

Source: EViews 9 Output, Processed (2025)

Examining the test results in Table 1, the probability values for both Cross-section F and Cross-section Chi-square are 0.0000. Since the significance value is lower than the alpha level of α=0.05 (0.0000 < 0.05), the statistical decision is to reject H<sub>0</sub> and accept H<sub>a</sub>. This indicates that the Fixed Effect (FE) model is more appropriate and reliable for estimating the influence of education,

minimum wage, and HDI on poverty across the regencies/cities of North Sumatra Province compared to the Common Effect (CE) model. The selection of the Fixed Effect model at this stage suggests the presence of significant region-specific (individual) effects; therefore, the testing procedure must proceed to the Hausman Test to determine the superior model between Fixed Effect and Random Effect.

### Hausman Test

Table 2. **Hausman Test**

<b>Correlated Random Effects – Hausman Test</b>			
<b>Test cross-section fixed effect</b>			
<b>Test Summary</b>	<b>Chi-Sq Statistic</b>	<b>Chi-Sq d.f.</b>	<b>Prob.</b>
Cross-section random	24,5512	3	0.0001

Source: EViews 9 Output, Processed (2025)

Based on the test results in Table 2, the probability value for the Cross-section random is 0.0001. Given that this significance value is substantially lower than the alpha level of  $\alpha=0.05$  ( $0.0001 < 0.05$ ), the statistical decision is to reject  $H_0$  and accept  $H_a$ . The substantive interpretation of this result confirms that the Fixed Effect Model (FEM) is more consistent and efficient in explaining the dynamics of poverty in North Sumatra Province compared to the Random Effect Model (REM). This is due to the strong heterogeneity or specific characteristics within each of the 33 regencies/cities in North Sumatra that correlate with the independent variables in the model. Since the Fixed Effect Model (FEM) has been selected as the best estimation model through both the Chow and Hausman tests, the analysis can proceed without the need for the Lagrange Multiplier (LM) test.

### Multicollinearity Test

Table 3. **Multicollinearity Test**

<b>Variable</b>	<b>Education</b>	<b>Minimum Wage</b>	<b>Human Development Index</b>
Education	1.0000	0.4251	0.6124
Minimum Wage	0.4251	1.0000	0.5514
Human Development Index	0.6124	0.5514	1.0000

Source: EViews 9 Output, Processed (2025)

Examining the multicollinearity test results in Table 3, it is evident that all correlation coefficient values between the independent variables (Education, Minimum Wage, and Human Development Index) are below 0.80. The highest correlation is found between the Education and Human Development Index (HDI) variables at 0.6124. Theoretically, this is expected since education is one of the dimensions forming the HDI; however, this value does not reach the category of extreme correlation. Consequently, it can be concluded that there is no serious multicollinearity issue in this research model. Thus, the assumption of independence between variables is met, allowing the regression model to provide unbiased and reliable coefficient estimates.

### Heteroskedasticity Test

Table 4. **Heteroskedasticity Test**

<b>Variabel</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
Education	0.0124	0.0451	0.2749	0.7836
Minimum Wage	-0.0052	0.0128	-0.4062	0.6848
Human Development Index	0.0315	0.0524	0.6011	0.5482
C	1.1245	2.5412	0.4425	0.6584

a. Dependent Variable: RESID

Source: EViews 9 Output, Processed (2025)

Reading the test results in Table 4, it is observed that the probability values (Prob.) for the three independent variables Education (0.7836), Minimum Wage (0.6848), and the Human Development Index (0.5482), all exceed the significance level of  $\alpha=0.05$ . This indicates that, partially, none of the independent variables have a significant effect on the absolute value of the residuals. Consequently,

it can be concluded that the panel data regression model in this study is free from heteroscedasticity issues. In other words, the variance of the residuals remains constant from one observation to another (homoscedasticity), thus fulfilling the requirements for the Best Linear Unbiased Estimator (BLUE).

### Panel Data Regression Estimation (Fixed Effect Model)

Table 5. Multiple Regression Analysis (Fixed Effect Model)

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
Konstanta	45.1245	5.2145	8.6536	0.0000
Education	-0.4215	0.1245	-3.3855	0.0008
Minimum Wage	-1.2541	0.4125	-3.0402	0.0026
Human Development Index	-0.6512	0.1845	-3.5295	0.0005

a. Dependent Variable: Kemiskinan

### Effects Specification

#### Cross-section fixed (dummy variables)

R Square	0.8942
Adjusted R Square	0.8715
F-statistic	35.4124
Prob(F-statistic)	0.0000

Source: EViews 9 Output, Processed (2025)

Referring to the panel data regression estimation results in Table 5, the following regression equation is obtained:

$$Y_{it} = 45.1245 - 0.4215X1_{it} - 1.2541X2_{it} - 0.6512X3_{it} + \varepsilon_{it}$$

The constant value of 45.1245 indicates that if the variables for Education, Minimum Wage, and HDI are assumed to be constant (zero), the poverty rate in North Sumatra Province would stand at 45.12 percent. The regression coefficients for all three independent variables are negative, indicating that every increase in Education, Minimum Wage, and HDI will be followed by a decrease in the poverty rate within the region.

### t-Test

Based on Table 5, the t-test results show that the Education variable (X1) has a Prob. value of 0.0008, the Minimum Wage (X2) has a value of 0.0026, and the HDI (X3) has a value of 0.0005. Since all three probability values are lower than  $\alpha=0.05$ , it is concluded that Education, Minimum Wage, and HDI partially have a negative and significant influence on Poverty in North Sumatra Province from 2015 to 2024. This proves that strengthening human capital and financial welfare can effectively reduce poverty rates.

### F-Test

Examining the results in Table 5, the F-statistic is 35.4124 with a Prob(F-statistic) of 0.0000. Because the significance value is substantially lower than 0.05, it can be concluded that, simultaneously, the Education, Minimum Wage, and Human Development Index variables have a significant effect on Poverty levels across the 33 Regencies/Cities of North Sumatra Province. The model is declared "fit" and appropriate for explaining the dynamics of poverty in the region.

### Coefficient of Determination

Reading Table 5, the Adjusted R-squared value is 0.8715. This indicates that 87.15% of the variation in the rise and fall of poverty rates in North Sumatra Province can be explained by the Education, Minimum Wage, and HDI variables. Meanwhile, the remaining 12.85% is explained by other variables outside this research model, such as economic growth, investment, or social assistance.

## Discussion

### The Influence of Education on Poverty

The panel data regression estimation results show that the education variable has a coefficient of -0.4215 with a probability value of 0.0008 ( $<0.05$ ). This indicates that education has a negative and significant influence on poverty levels across the 33 Regencies/Cities of North Sumatra Province

during the 2015-2024 period. Statistically, every one-year increase in the mean years of schooling of the population in North Sumatra will significantly impact the reduction of the poverty percentage. This finding confirms that investment in the education sector is a crucial determinant in poverty reduction strategies at the regional level.

Theoretically, the negative relationship between education and poverty is consistent with human capital theory. Todaro & Smith (2020) argue that education is a primary investment that enhances labor productivity and individual capabilities, which in turn opens access to higher income opportunities. In line with this, Mulyadi (2019) emphasizes that higher education provides a competitive advantage for the workforce in winning competition within a modern labor market that increasingly demands specific expertise. Arsyad (2022) further asserts that education serves as a breaker of the “vicious circle of poverty” because, through education, people possess the knowledge to manage economic resources more efficiently, thereby enabling them to escape the poverty line.

The results of this study reinforce the findings of Surbakti et al. (2023), who stated that education levels in Indonesia consistently serve as a driving factor for poverty reduction due to their influence on the national income structure. Similar consistency was also found by Tjiabrata et al. (2021) in North Sulawesi and Isroviyah (2021) at the national level, both of whom concluded that improved access to education is the most effective instrument for income redistribution. Furthermore, these findings support the research of Ishak et al. (2020), which highlighted that in urban areas, quality education is capable of reducing poverty rates by decreasing the level of educated unemployment and increasing community purchasing power.

### **The Influence of Minimum Wage on Poverty**

Based on the panel data regression estimation results, the Minimum Wage variable has a coefficient of -1.2541 with a probability value of 0.0026 ( $<0.05$ ). This result indicates that the Minimum Wage has a negative and significant influence on poverty levels across the 33 Regencies/Cities of North Sumatra Province during the 2015-2024 period. This implies that every increase in the minimum wage standards set by the local government effectively contributes to the reduction of the poor population. The relatively large coefficient compared to other variables suggests that wage policy is a highly sensitive instrument in influencing the purchasing power of the lower-income groups (formal workers) in North Sumatra.

Theoretical analysis suggests that an increase in the minimum wage functions as an income redistribution mechanism that enhances the welfare of working households. Borjas (2023) explains that in the labor market, setting a minimum wage above the equilibrium wage can increase the income of unskilled workers, provided it does not trigger massive labor reductions. Ehrenbreg & Smith (2021) add that an effective minimum wage policy can improve the standard of living and reduce community dependency on government social assistance. In the domestic context, Tambun (2021) emphasizes that the minimum wage in Indonesia is designed as a social safety net ensuring that workers can meet their Minimum Living Needs (KHM), thereby directly lifting the community's position from below the poverty line toward a more humane standard of living.

The results of this study are in line with the findings of Balqis et al. (2025) in Aceh Province, which concluded that the minimum wage is a crucial instrument in suppressing regional poverty rates through increased household consumption. This consistency is also supported by Chairunnisa & Qintharah (2022) in West Java and Putri & Putri (2021) at the national level, proving that minimum wage policy has a direct impact that is felt more rapidly by the poor compared to long-term infrastructure investment. Furthermore, these findings reinforce the research by Sari (2021) in Central Java, which highlights that a minimum wage increase is capable of reducing economic inequality and significantly lowering poverty rates, provided it is balanced with controls over the regional inflation rate to maintain real purchasing power.

### **The Influence of the Human Development Index on Poverty**

The panel data regression estimation results show that the Human Development Index (HDI) variable has a coefficient of -0.6512 with a probability value of 0.0005 ( $<0.05$ ). This finding proves that the HDI has a negative and significant influence on poverty levels across the 33 Regencies/Cities of North Sumatra Province during the 2015-2024 period. This means that every improvement in the

quality of human development encompassing the dimensions of a long and healthy life, knowledge, and a decent standard of living is effectively capable of reducing poverty rates in North Sumatra. This coefficient emphasizes that the HDI is a fundamental macro variable in intervening in poverty issues because it reflects the aggregate basic capabilities of the community.

Theoretical analysis reinforces these findings through the concept of human capital developed by Becker (1993), which states that improving human quality through health and skills is a primary economic asset that determines individual productivity to escape poverty. Brata (2020) adds that sound human development at the local level will create a more resilient economic base because the community has broader access to economic choices. This is in line with the view of Mulyadi (2019), who emphasizes that human resources are both the subject and object of development, where high-quality individuals have a greater opportunity to avoid the risk of poverty. Arsyad (2022) concludes that a high HDI reflects the government's success in providing basic social infrastructure, which simultaneously reduces the number of people below the poverty line by increasing labor market efficiency and economic empowerment.

The results of this study are consistent with the findings of Rombo et al. (2024) in Poso Regency and Setiyani & Sutikno (2024), who state that HDI improvement is the primary key in long-term poverty alleviation strategies. Research by Praja et al. (2023) in DKI Jakarta also shows that HDI dimensions have strong momentum in reducing urban poverty through the improvement of purchasing power. Furthermore, these findings reinforce the study by Saragih et al. (2022) in a national context as well as region-specific research in North Sumatra by Sembiring et al. (2019), both of whom concluded that the HDI determinant has the most consistent negative correlation with poverty compared to other macro variables. This indicates that regions in North Sumatra with high HDI scores tend to have better resilience against economic shocks that cause poverty.

### **The Simultaneous Influence of Education, Minimum Wage, and the Human Development Index on Poverty in North Sumatra Province (2015-2024)**

The panel data regression analysis results show that, simultaneously, the variables of Education, Minimum Wage, and the Human Development Index (HDI) have a significant and negative influence on poverty levels across the 33 Regencies/Cities of North Sumatra Province during the 2015-2024 period. An F-statistic value of 35.4124 with a probability of 0.0000 proves that this model possesses a very high degree of goodness of fit in explaining the phenomenon of poverty in the region. The Adjusted R-squared value of 0.8715 indicates that the combination of these three variables is capable of explaining 87.15% of the variation in poverty rates in North Sumatra. This finding emphasizes that poverty alleviation cannot be achieved through partial measures but must be addressed through policy integration that encompasses human resource capacity building, fair wage protection, and multidimensional quality-of-life improvements.

Theoretically, the integration of these three variables reflects a systematic effort to break the “poverty trap” as described by Banerjee & Duflo (2019). Ravallion (2016) asserts that poverty is a failure to achieve a minimum standard of living, which, from the perspective of Todaro & Smith (2020), can only be overcome through inclusive economic development. Education and HDI play a role in increasing the marginal productivity of labor (Borjas, 2023; Ehrenberg & Smith, 2021), while the Minimum Wage acts as a safety net to ensure that productivity results are converted into real purchasing power. Brata (2020) and Mulyadi (2019) view this synergy as the foundation of local development, where high-quality and financially sufficient individuals become the primary subjects of growth. Suryawati (2021) and Arsyad (2022) add that the simultaneous improvement of these macro variables will increase community savings and investment, thereby halting the vicious circle of poverty. Faried & Sembiring (2019) emphasize that sustainable development in North Sumatra relies heavily on the synchronization between education policy and worker welfare standards to maintain regional economic stability.

Comparative analysis shows that these findings in North Sumatra are highly consistent with the results of Kurniawan et al. (2024), who reviewed the macroeconomic analysis of poverty across the entire island of Sumatra. The effectiveness of HDI as a primary determinant is also emphasized by Mirantika et al. (2025) and Silvia et al. (2025), who observed that strengthening human development

dimensions serves as a catalyst for poverty reduction in primary production centers. This synergy between education and the minimum wage is also supported by the findings of Balqis et al. (2025) in Aceh and Chairunnisa & Qintharah (2022) in West Java. More broadly, these results reinforce the studies of Putri & Putri (2021) and Radityana et al. (2023), who found that wage policy and HDI are the main pillars of poverty alleviation in various provinces across Indonesia. Studies by Rivana & Gani (2024) and Ashari & Athoillah (2023) also confirm that without improving the quality of human resources, wage policy alone will not be strong enough to permanently suppress poverty rates. Furthermore, Nasution et al. (2020) and Laoli et al. (2025) remind us that the success of these variables in North Sumatra must also be supported by efficient fiscal policies to ensure the impact of poverty reduction is felt equitably even in remote areas.

### Conclusions and Recommendations

Based on the results of the panel data analysis using the Fixed Effect Model across 33 Regencies/Cities in North Sumatra Province from 2015 to 2024, it can be concluded that the variables of Education, Minimum Wage, and the Human Development Index (HDI) simultaneously have a significant influence on reducing poverty rates, with an explanatory power of 87.15%. Partially, all three variables exert a significant negative influence, proving that improvements in human capital quality and wage standards are the most effective instruments for enhancing community welfare in real terms. These findings emphasize that the poverty alleviation strategy in North Sumatra must be implemented through an integrated approach that combines improved access to quality education, wage policy settings that guarantee purchasing power, and the strengthening of health and living standard dimensions as encapsulated in HDI achievements.

This research is limited by the use of macro-level secondary data, which may not fully capture the dynamics of structural poverty at the household level specifically in each region. Furthermore, this model does not yet incorporate external variables such as regional inflation rates, real sector economic growth, and the impact of non-natural disasters that may have influenced the volatility of poverty figures during the observation period. Therefore, future research is recommended to expand the scope of independent variables by including elements of income inequality (Gini Ratio) or regional bureaucratic governance variables. For the Provincial Government of North Sumatra, it is advised to prioritize budget allocations toward the sectors forming the HDI, particularly in regencies/cities with the lowest indices, to create development convergence that can accelerate the rate of poverty reduction equitably across all regions.

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