

Education, Unemployment, and Health as Determinants of Poverty in Central Sulawesi: District-Level Panel Evidence

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ABSTRACT

Purpose – This research investigates the impact of education, unemployment, and health on poverty in Central Sulawesi Province. The study is motivated by the persistently high poverty rate and substantial disparities across districts and cities, highlighting the need for district-level empirical analysis.

Design/methodology/approach – This study employs a quantitative approach using balanced panel data from 13 districts/cities in Central Sulawesi during 2017–2024 (104 observations). Data from Statistics Indonesia (BPS) were analyzed using the Random Effect Model with education, unemployment, and health as the explanatory variables. Model selection was conducted using the Chow, Hausman, and Lagrange Multiplier tests, while robustness was examined by incorporating year fixed effects into the estimation model.

Findings/Results – The findings suggest that education and health have negative and statistically significant influences on poverty, while unemployment has a favorable albeit statistically negligible impact. Simultaneously, education, unemployment, and health significantly influence poverty, with an Adjusted R-squared value of 0.619.

Originality/Value – This study provides district-level panel evidence on the determinants of poverty in Central Sulawesi by integrating panel data analysis with an Islamic economics perspective. The findings contribute to the formulation of poverty reduction policies through improvements in education and health, the expansion of employment opportunities, and the optimization of Islamic social finance instruments.

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1. Introduction

In the 21st century, poverty continues to be one of the most persistent structural challenges in developing countries. It is now recognized as a multidimensional condition that necessitates a more comprehensive analysis than monetary indicators alone, as it is associated with restricted access to education, health services, and a decent standard of living ([Imantria, 2024](#); [Naz, 2023](#); [Nurhalisa et al., 2026](#)). Globally, post-pandemic recovery has widened human development disparities, particularly in countries facing structural vulnerabilities, thereby slowing poverty reduction efforts ([Febriani et al., 2026](#); [Wardhana et al., 2023](#)). In Indonesia, although the national poverty rate declined from 17.75 percent in 2006 to below 10 percent in 2024, significant regional disparities remain. Provinces outside Java continue to experience relatively higher poverty rates, reflecting unequal educational attainment, health conditions, and employment opportunities ([Agussalim et al., 2024](#)).

Central Sulawesi Province illustrates these regional disparities. Poverty declined from 14.14 percent in 2017 to 11.77 percent in 2024, but the reduction was slower than the national average and remained uneven across its 13 districts and cities. Donggala Regency recorded an average poverty rate of 17.07 percent, whereas Palu City recorded only 6.66 percent. The provincial economy remains dominated by agriculture, fisheries, and mining, making many workers vulnerable to income fluctuations and limiting economic mobility ([Ladjin, Mambuhu, et al., 2024](#)). These structural conditions were further intensified by the 2018 earthquake and tsunami, while district-level panel studies capturing these spatial dynamics remain limited ([Machmud & Sidharta, 2023](#); [Syamsu et al., 2025](#); [Wurarah et al., 2025](#)).

Education, unemployment, and health are widely acknowledged as critical factors that are associated with poverty. Human Capital Theory regards education as an investment that enhances productivity, income opportunities, and skills ([Caire, 1967](#); [Muhlisin, Sakti, & Subroto, 2026](#)), whereas unemployment reflects underutilized human capital that may increase poverty risk ([Desanta & Aisyah, 2025](#); [Sofyan et al., 2023](#)). Health also enhances productivity and well-being. From the Capability Approach perspective, education and health represent basic capabilities that expand individuals' opportunities and freedoms, making poverty reduction a matter of capability expansion rather than income alone ([Nazamuddin et al., 2026](#); [Sen, 1999](#)).

Empirical findings on the relationship between education, unemployment, and human development with poverty in Indonesia remain mixed. Several studies report that better education and health are associated with lower poverty, while the effect of unemployment varies across regions ([Aminda et al., 2024](#); [Syamsu et al., 2022](#); [Wurarah et al., 2025](#)). Ahsan Pramana Desanta further show that a mismatch between educational outcomes and labor market needs can weaken the poverty-reducing effect of education ([Desanta & Aisyah, 2025](#)). At the district/city level in Central Sulawesi Province, panel studies examining education, unemployment, and health simultaneously are still relatively limited. Research [Ladjin et al. \(2024\)](#), while [Machmud and Sidharta, \(2023\)](#) analyzed regional development and poverty without district-level analysis. Additionally, the Human Development Index (HDI) has been employed as a composite indicator in numerous prior studies, which complicates the evaluation of the distinct contributions of education and health. Consequently, this investigation examines education, unemployment, and health as independent variables in order to ascertain their precise correlation with poverty.

This investigation also employs an Islamic economics perspective as an interpretive framework. In Islamic economics, poverty is indicative of the inability to attain the objectives of *maqashid al-shariah*, which include the preservation of religion, life, intellect, lineage, and fortune, in addition to insufficient income (Musaddad et al., 2025; Tumewang et al., 2025). Education is associated with *hifz al-'aql*, health with *hifz al-nafs*, and employment opportunities with *hifz al-mal* within this framework. The empirical findings are interpreted from the *maqashid al-shariah* perspective, rather than as a mechanism that is tested in the econometric model. This approach offers a more comprehensive normative understanding of poverty in Central Sulawesi (Cipta et al., 2026; Novreska & Arundina, 2024; Riani & Indra, 2026; Fitrianti et al., 2026) .

Based on these gaps, this study makes three contributions. First, it provides district-level panel evidence from 13 districts and cities in Central Sulawesi during 2017–2024, capturing both pre- and post-pandemic development dynamics. Second, it examines education and health separately, together with unemployment, allowing a clearer identification of each factor's contribution than studies using HDI. Third, it integrates the *maqashid al-shariah* perspective as an interpretive framework for poverty analysis in a Muslim-majority region (Riani & Indra, 2026; Suliswanto et al., 2025) .

This study addresses four questions: (1) What are the conditions of education, unemployment, health, and poverty across districts and cities in Central Sulawesi during 2017–2024? (2) Does education affect poverty? (3) Does unemployment affect poverty? and (4) Does health affect poverty? The study aims to provide empirical evidence for poverty reduction policies through improvements in education, employment opportunities, and health, while interpreting the findings through the *maqashid al-shariah* perspective.

This article is organized into six sections. The first presents the research background, problem formulation, objectives, and significance. The second reviews the theoretical framework and previous studies. The third describes the data, variables, and econometric methods. The fourth presents the empirical results, the fifth discusses the findings from an Islamic economics perspective, and the sixth concludes with policy implications, limitations, and suggestions for future research.

2. Literature Review and Hypothesis Development

2.1 Theoretical Foundation

This study is grounded in three complementary theoretical frameworks: Human Capital Theory, the Capability Approach, and an Islamic economics perspective based on *maqashid al-shariah*. Human Capital Theory explains that investments in education, skills, and health constitute productive capital embedded in individuals, increasing labor productivity, employment opportunities, and income, thereby reducing poverty (Caire, 1967). Within this framework, education improves human resource quality, while health enables individuals to work productively and sustain their earning capacity (Lestari et al., 2022; Nazamuddin et al., 2026) .

The Capability Approach proposed by Amartya Sen shifts the focus from income to individual capabilities. Sen (1999) argues that poverty represents capability deprivation, meaning limitations in achieving a life that individuals value. Accordingly, education and health are

regarded as basic capabilities that expand employment opportunities, well-being, and the ability to escape poverty (Amate-Fortes et al., 2017; Aminda et al., 2024).

By observing poverty not only as an economic condition but also as the failure to achieve the objectives of maqashid al-shariah, including the protection of religion (hifz al-din), life (hifz al-nafs), intellect (hifz al-'aql), lineage (hifz al-nasl), and wealth (hifz al-mal), Islamic economics offers a normative perspective. Education is linked to hifz al-'aql, health is linked to hifz al-nafs, and employment and income are linked to hifz al-mal in this study. This perspective is employed to interpret the relationship between education, unemployment, health, and poverty, rather than as an empirically tested mechanism (Musaddad et al., 2025; Tumewang et al., 2025). Despite the fact that these frameworks are derived from distinct intellectual traditions, they are united in their emphasis on the importance of enhancing education and health in order to reduce poverty. The Capability Approach emphasizes expanded freedoms and opportunities, while the Human Capital Theory emphasizes productivity gains. Islamic economics connects both dimensions to the realization of maqashid al-shariah. In this study, the conceptual foundation for analyzing the relationship between education, unemployment, health, and poverty is provided by these perspectives.

2.2 Education and Poverty

Education is a key mechanism through which human capital investment contributes to poverty reduction by expanding access to formal employment, increasing wages, and strengthening households' resilience to economic shocks (Caire, 1967; Muhlisin et al., 2026). Evidence at the national level in Indonesia generally supports this relationship. Nursini et al. (2026) found that women's educational participation significantly reduces poverty across provinces, while Chammearc and Ratnasih, (2023) showed that improvements in human capital, including education, are associated with lower income inequality.

At the sub-provincial level, however, findings remain mixed. Febrianti and Hailuddin, (2025) reported that mean years of schooling did not significantly reduce poverty in districts of West Nusa Tenggara because of mismatches between educational outcomes and local labor market demand. Similarly, Yusriana et al. (2021) found that education improves welfare only when accompanied by adequate skilled employment opportunities, and Machmud and Sidharta, (2023) showed that educational improvements do not uniformly reduce poverty under unfavorable regional economic conditions. Theoretical arguments and national-level evidence generally indicate a negative correlation between education and poverty, despite these inconsistencies. Education is a reflection of hifz al-'aql from the maqashid perspective, which further corroborates the hypothesis that higher education is linked to reduced poverty. This leads to the following hypothesis:

H1: Education has a significant negative effect on poverty in Central Sulawesi.

2.3 Unemployment and Poverty

Unemployment eliminates earned income and directly curtails household consumption, thereby amplifying the risk of poverty through the most direct channel. At the macro level, regions with persistently high open unemployment rates are expected to exhibit higher poverty incidence, as households without employment income are structurally more vulnerable to falling below poverty thresholds (Desanta & Aisyah, 2025; Imantria, 2024). Febriani et al. (2026) confirmed a dynamic poverty trap mechanism in Indonesia, in which

unemployment serves as a key transition variable, pushing households into persistent poverty, particularly in structurally weak regional economies. [Wardhana et al. \(2023\)](#) Similarly, unemployment was identified as one of the demographic and economic factors most strongly associated with multidimensional poverty outcomes across Indonesian districts.

In economies characterized by large informal sectors, however, the statistical relationship between registered unemployment — measured by the open unemployment rate — and poverty may be substantially attenuated. Individuals classified as unemployed in official statistics may sustain subsistence incomes through informal economic activities, family transfers, or agricultural self-employment, all of which fall outside the formal unemployment measure ([Desanta & Aisyah, 2025](#)). The open unemployment rate may systemically underestimate the actual economic vulnerability in the Central Sulawesi context, where a significant portion of the workforce is involved in informal trade, littoral fisheries, and subsistence farming. From an Islamic economics standpoint, unemployment constitutes a direct violation of *hifz al-mal* by depriving individuals of legal earnings (*kasb halal*), rendering its reduction both an economic and a normative imperative ([Fatoni et al., 2019](#); [Suliswanto et al., 2025](#)). Based on both theoretical expectations and the weight of empirical evidence, the following hypothesis is proposed:

H2: Unemployment has a significant positive effect on poverty in Central Sulawesi.

2.4 Health and Poverty

Health is an important component of human capital that enhances productivity, work capacity, and individual well-being. Human Capital Theory argues that investment in health increases physical and mental capacity, extends productive working life, and improves income-earning opportunities ([Caire, 1967](#)). In this study, health is proxied by Life Expectancy (UHH), which reflects overall public health conditions. Higher life expectancy indicates better health outcomes and is therefore expected to increase productivity and reduce poverty. Similarly, the Capability Approach views health as a fundamental capability that enables individuals to improve their quality of life and escape poverty ([Sen, 1999](#)).

In general, empirical evidence indicates that poverty and life expectancy are negatively correlated. [Bahtia et al. \(2025\)](#) and [Imantria, \(2024\)](#) found that higher life expectancy significantly reduces poverty in Indonesia by improving human capital and productivity. However, other studies report mixed findings. [Samudra and Wahed \(2023\)](#) found that life expectancy affects poverty indirectly through open unemployment, while [Hasanah, Syaparuddin, and Rosmeli \(2021\)](#) reported a positive relationship between life expectancy and the poverty line in Southeast Minahasa Regency. These differences suggest that the effect of health on poverty depends on regional economic conditions and labor market structures, highlighting the need for further district-level evidence from Central Sulawesi Province.

From the maqashid al-shariah perspective, health is associated with *hifz al-nafs* and is considered essential for productive economic activity and social welfare ([Isa et al., 2023](#); [Nazamuddin et al., 2026](#)). Improving health therefore has both economic and normative value, as better health increases productivity, income, and resilience against poverty ([Musaddad et al., 2025](#); [Riani & Indra, 2026](#)). This theoretical and empirical convergence generates the following hypothesis:

H3: Health has a significant negative effect on poverty in Central Sulawesi.

2.5 Simultaneous Effects and Research Framework

Although education, unemployment, and health have different mechanisms of influence on poverty, these three variables are theoretically important factors that determine the level of community welfare. From the perspective of Human Capital Theory, education and health are forms of human capital investment that increase productivity, the ability to earn income, and the quality of life of individuals. Conversely, unemployment reflects the suboptimal utilization of human capital, thereby reducing people's opportunities to earn income and increasing the risk of poverty (Caire, 1967). Meanwhile, the Capability Approach emphasizes that expanding capabilities through improved education and health is an important prerequisite for society to achieve a more prosperous life, while high unemployment can limit an individual's ability to utilize these capabilities optimally (Sen, 1999).

Various empirical studies also show that education, unemployment, and health are important determinants of poverty that need to be analyzed together in one empirical model (Bahtia et al., 2025; Imantria, 2024). The objective of simultaneous testing is to determine whether these three variables collectively have a substantial correlation with the poverty level, taking into account the individual contributions of each variable in the regression model. In the context of *maqashid al-shariah*, poverty alleviation initiatives necessitate consideration of a variety of human welfare aspects, including education (*hifz al-'aql*), health (*hifz al-nafs*), and economic welfare (*hifz al-mal*), which collectively facilitate the attainment of community welfare. The following hypothesis is proposed, as supported by the theoretical and empirical foundations. (Musaddad et al., 2025; Suliswanto et al., 2025). Grounded in this integrated theoretical and normative reasoning, the following final hypothesis is advanced:

H4: Education, unemployment, and Health simultaneously have a significant effect on poverty in Central Sulawesi.

3. Methodology

3.1 Research Design and Data

This study uses a quantitative approach with a panel research design, which combines time series data for eight years (2017–2024) with cross-sectional data from 13 districts/cities in Central Sulawesi Province. The panel data approach was chosen because it can utilize inter-regional and inter-temporal variations simultaneously, while controlling for unobserved heterogeneity in each district/city, which is relatively constant throughout the study period (Sihombing & Arsani, 2021). The selection of districts/cities as the unit of analysis is based on differences in socioeconomic characteristics and poverty levels between regions in Central Sulawesi Province, so the use of panel data is considered more appropriate to capture these spatial and temporal variations. This study uses 104 observations forming a balanced panel (13 districts/cities × 8 years). All data used are secondary data obtained from official publications of the Central Statistics Indonesia (BPS) of Central Sulawesi Province and district/city BPS (Badan Pusat Statistik, 2024). The sampling technique used saturated sampling, namely all 13 districts/cities were used as research samples to obtain comprehensive regional coverage and increase the representativeness of the analysis results (Wurarah et al., 2025).

3.2 Variables and Measurement

This study operationalizes four research variables. The dependent variable (Y) is the poverty rate, measured by the percentage of the population with average monthly per capita expenditure below the poverty line set by the Central Statistics Indonesia (BPS). The independent variables are education (X_1), measured using the Average Years of Schooling (RLS) in years; unemployment (X_2), measured using the Open Unemployment Rate (TPT) as a percentage of the labor force; and health (X_3), proxied by Life Expectancy (UHH) at birth in years. Life Expectancy was chosen as a health indicator because it reflects aggregate public health development achievements and illustrates the chances of a longer life as a result of improvements in the quality of health services, nutritional status, and community living conditions. The operationalization of these variables refers to empirical practices commonly used in poverty research at the regional level in Indonesia (Samudra & Wahed, 2023). Table 1 presents the operational definitions and measurement indicators of all variables used in this study.

Table 1. Operational Definition of Variables

Variable	Definition	Indicator	Scale
Poverty Rate (Y)	Percentage of the population whose average monthly per capita expenditure falls below the official poverty line	Percentage of poor population (BPS)	Ratio
Education (X_1)	Average number of years of formal schooling completed by residents aged 25 years and above	Mean Years of Schooling (MYS)	Ratio
Unemployment (X_2)	Proportion of the labor force actively seeking employment but currently without work.	Open Unemployment Rate (OUR, %)	Ratio
Health (X_3)	The overall health status of the population.	Life Expectancy at Birth (Years)	Ratio

Source: BPS Central Sulawesi Province (2017–2024, processed)

3.3 Model Specification

The panel data regression model is specified as follows:

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_{it} \quad (1)$$

where Y_{it} denotes the poverty rate in district i at time t ; α is the model intercept; β_1 , β_2 , and β_3 are the partial regression coefficients for education, unemployment, and health, respectively; and ε_{it} is the stochastic error term.

3.4 Model Selection

This study evaluates three panel data estimation models as candidate regressions: the Common Effect Model (CER), the Fixed Effect Model (FER), and the Random Effect Model (REM). Model selection is carried out through a step-by-step testing procedure. The first stage uses the **Chow test** to determine whether the Common Effect Model or the Fixed Effect Model is more appropriate. The Chow test results show a probability value of 0.0000 (<0.05), so the null hypothesis is rejected. These results indicate that the Fixed Effect Model is more appropriate than the Common Effect Model, indicating that there are differences in characteristics between districts/cities that need to be taken into account in the

model. Next, the Hausman test is conducted to compare the Fixed Effect Models with Random Effect Model. The test results show a probability value of 0.1607 (> 0.05), so the null hypothesis is not rejected. Based on these results, the Random Effect Model was chosen as the more appropriate model based on the commonly used panel data model selection procedure. The final stage was carried out through the Lagrange Multiplier (LM) test to compare the Common Effect Model with the Random Effect Model. The test results showed a probability value of 0.0000 (< 0.05), so the Random Effect Model was considered more appropriate than the Common Effect Model. Based on a series of Chow, Hausman, and Lagrange Multiplier test results, this study used the Random Effect Model (REM) which was estimated using the Estimated Generalized Least Squares (EGLS) method, as an estimation model used in the analysis (Sihombing & Arsanir, 2021; Wurarah et al., 2025). The REM specification is:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + u_i + \varepsilon_{it} \quad (2)$$

where u_i represents the individual-specific random effect capturing unobserved, time-invariant district-level heterogeneity, assumed to be uncorrelated with all regressors, and ε_{it} is the idiosyncratic error term capturing residual stochastic variation.

3.5 Classical Assumption Tests

Before hypothesis testing, the model was first evaluated using classical assumption tests to ensure the feasibility of the estimation model. The tests included normality, multicollinearity, and heteroscedasticity tests. The Jarque–Bera test yielded a probability value of 0.34, which is greater than the 0.05 significance level, thus declaring the residuals normally distributed. The multicollinearity test was performed using the Variance Inflation Factor (VIF), where all independent variables had Centered VIF values below 10, indicating no multicollinearity symptoms. Furthermore, the Glejser test for heteroscedasticity was performed. The test results showed that education ($p = 0.90$), unemployment ($p = 0.80$), and health ($p = 0.51$) had probability values above 0.05, thus declaring the model free from heteroscedasticity problems. Thus, the test results indicate that the model has met the basic assumptions required in panel data regression analysis. All data processing in this study was performed using EViews 12 software (Nazamuddin et al., 2026; Sihombing & Arsani, 2021). All statistical computations were performed using EViews 12.

3.6 Hypothesis Testing

After the selected regression model was obtained, hypothesis testing was carried out in three stages. First, a partial test (t-test) was used to test the significance of the influence of each independent variable on the poverty rate at a significance level of 5% ($\alpha = 0.05$). Second, a simultaneous test (F-test) was used to test whether the variables of education, unemployment, and health together had a significant effect on the poverty rate. Third, the coefficient of determination (R^2) and Adjusted R^2 were used to measure the model's ability to explain variations in poverty rates. The Adjusted R^2 value was used as a more accurate measure because it took into account the number of independent variables and sample size, thus providing a more conservative estimate of the model's ability (Sihombing & Arsanir, 2021; Wurarah et al., 2025).

4. Results and Discussion

4.1 Descriptive Analysis

Table 2 presents the descriptive statistics for all four research variables across 104 panel observations drawn from 13 districts and cities in Central Sulawesi Province over the period 2017–2024.

Table 2. Descriptive Statistics of Research Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
Education / MYS (X_1)	6.98	11.75	8.78	0.97
Unemployment / OUR (X_2)	1.48	8.38	3.25	1.24
Health / LE (X_3)	63.19	71.56	67.96	2.41
Poverty Rate (Y)	5.94	18.40	13.55	3.18

Source: BPS Central Sulawesi Province, processed data, 2017–2024.

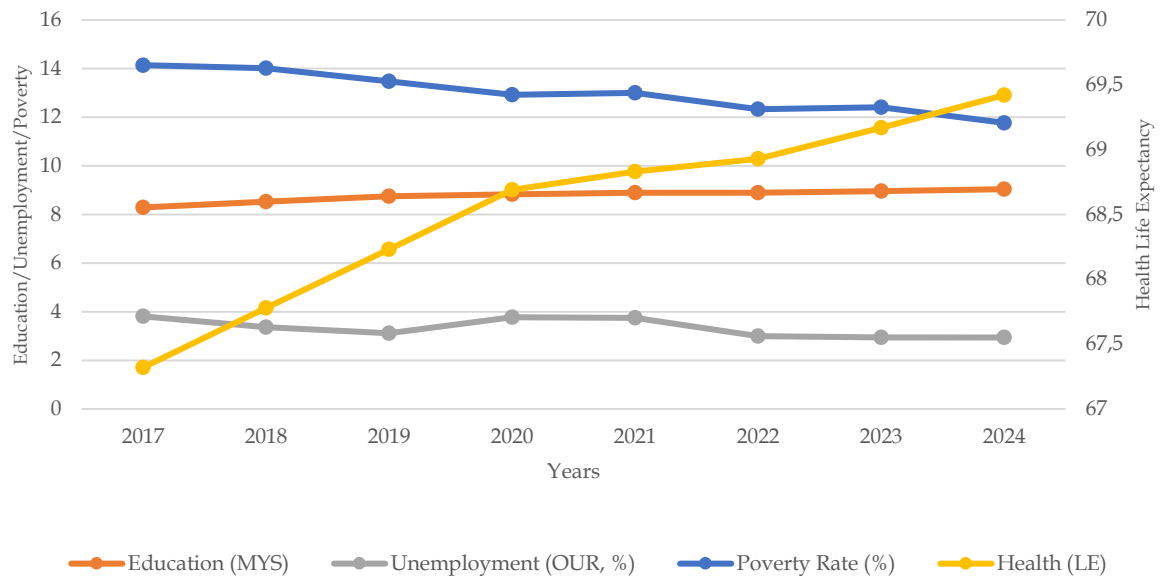
Based on Table 2, the average length of schooling in Central Sulawesi Province during the 2017–2024 period reached 8.78 years with a standard deviation of 0.97, indicating relatively moderate variation in education levels across districts/cities. The minimum value of 6.98 years and the maximum value of 11.75 years indicate that although educational attainment continues to increase, some regions have not yet achieved an average length of schooling equivalent to a full junior high school education. This condition indicates that educational access and attainment are still unequal across districts/cities. The Open Unemployment Rate had an average value of 3.25% with a standard deviation of 1.24, and ranged from 1.48% to 8.38%. This range indicates that labor market conditions in Central Sulawesi Province vary relatively across regions. Some districts/cities have been able to maintain low unemployment rates, while others still face challenges in creating adequate job opportunities.

The health variable, proxied by Life Expectancy (UHH), has an average of 67.96 years, with a minimum value of 63.19 years, a maximum value of 71.56 years, and a standard deviation of 2.41. This variation indicates that public health outcomes across districts/cities are relatively more equitable compared to other socioeconomic variables. However, there are still gaps in life expectancy, reflecting differences in the quality of health services, environmental conditions, and community access to health facilities. Meanwhile, the poverty rate has an average of 13.55% with a standard deviation of 3.18, and ranges from 5.94% to 18.40%. This wide range indicates a high disparity in poverty levels between districts/cities in Central Sulawesi Province. This difference indicates that the socioeconomic characteristics of each region are still very diverse, so analysis at the district/city level is important to identify factors that influence poverty in Central Sulawesi Province ([Machmud & Sidharta, 2023](#); [D. Wardhana, 2023](#)).

To complement the descriptive statistics in Table 2, a trend analysis is presented in Figure 1 to illustrate the development of each research variable during the 2017–2024 period. Unlike descriptive statistics, which only summarize data characteristics, trend analysis can show the direction of changes in education, open unemployment rates, life expectancy, and poverty rates from year to year. This visualization is important because the research period covers the post-disaster recovery phase of 2018 and the impact of the COVID-19 pandemic, which has the potential to impact regional socioeconomic conditions. Therefore, Figure 1 provides an

initial overview of the dynamics between variables before conducting panel data regression analysis.

Figure 1. Trends of Education, Unemployment, Health, and Poverty in Central Sulawesi, 2017–2024

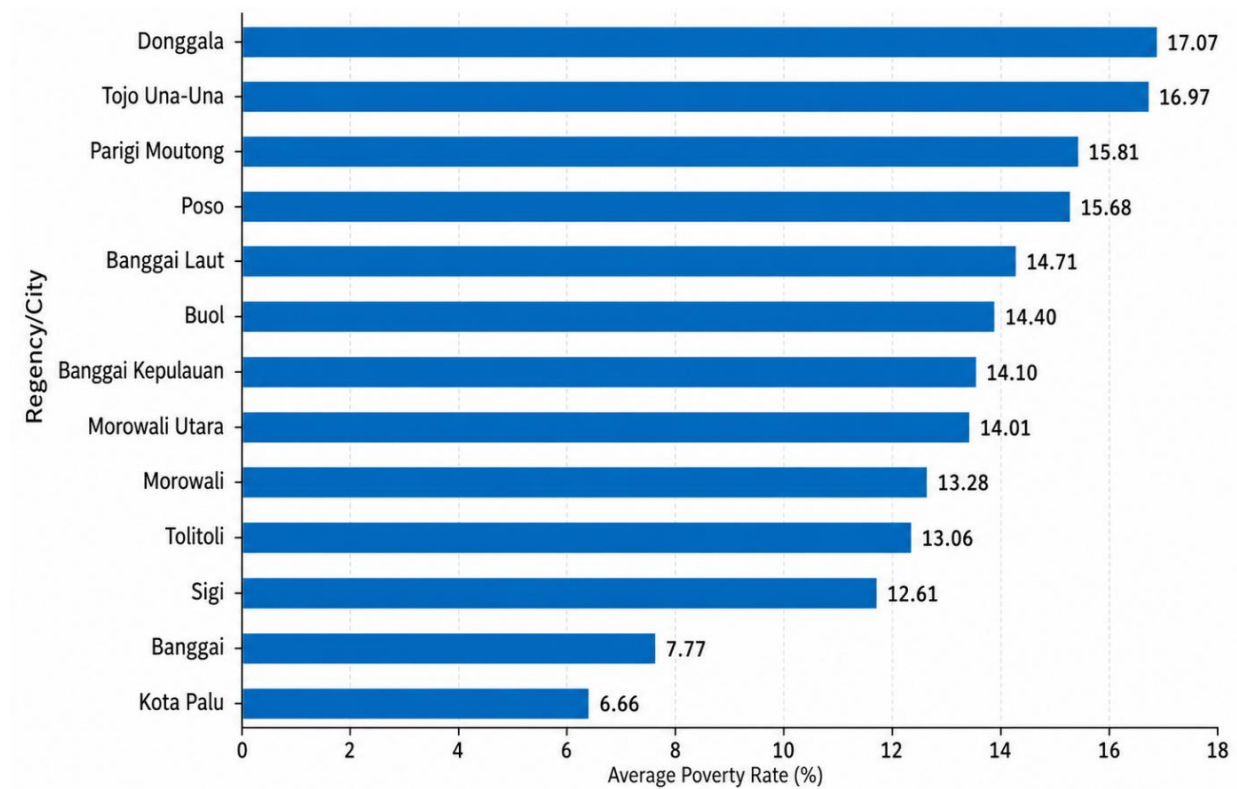


Source: BPS Central Sulawesi Province, processed data, 2026.

Figure 1 shows the average development of education, unemployment, health, and poverty rates in Central Sulawesi Province during the period 2017–2024. In general, education, measured by average years of schooling, and health, proxied by Life Expectancy (UHH), showed a continuous upward trend throughout the observation period. Conversely, the poverty rate showed a downward trend from year to year. This pattern descriptively indicates that improvements in the quality of human resources occur in line with the decline in the poverty rate in Central Sulawesi Province. Meanwhile, the open unemployment rate fluctuated, particularly in the 2020–2021 period, which coincided with the COVID-19 pandemic, before returning to a downward trend until 2024. This condition indicates that labor market dynamics during the study period were influenced by economic shocks, but their impact on poverty rates did not always move in the same direction due to the presence of various other factors that also influence community welfare. This pattern is consistent with the findings of [Desanta and Aisyah \(2025\)](#) and [Pahrudin and Darminto \(2021\)](#), which shows that informal economic activities and social protection programs play a role in mitigating the impact of increasing unemployment on poverty.

Beyond provincial trends, Figure 2 presents the average poverty levels across the 13 districts and cities of Central Sulawesi during 2017–2024. The figure highlights substantial spatial disparities in poverty associated with differences in geographic conditions, economic structures, infrastructure access, and regional development capacity, thereby supporting the use of district-level panel data in this study.

Figure 2. Average Poverty Rate by District/City in Central Sulawesi, 2017–2024



Source: BPS Central Sulawesi Province, processed data, 2026.

Figure 2 illustrates the pronounced spatial inequality in poverty outcomes across the province. Donggala records the highest average poverty rate at 17.07 percent, followed by Tojo Una-Una (16.97%), Parigi Moutong (15.81%), and Poso (15.68%). These districts are characterised by a concentration of smallholder agricultural employment, geographic remoteness from provincial service centres, limited access to health and educational facilities, and weak formal labour market absorption—structural conditions that collectively sustain elevated poverty rates despite provincial-level improvement trends (Ladjin, Mambuhu, et al., 2024). At the lower end of the distribution, Palu City records the lowest average poverty rate at 6.66 percent, followed by Banggai at 7.77 percent, both benefiting from stronger urban economic diversification, superior infrastructure connectivity, and more developed service and trade sectors. The near threefold difference between the highest and lowest poverty rates within a single province confirms that aggregate provincial statistics obscure critical spatial heterogeneity and reinforces the analytical necessity of district-level panel data studies of the kind undertaken here (Machmud & Sidharta, 2023).

4.2 Panel Model Selection and Diagnostic Tests

Table 3. Panel Data Model Selection Tests

Test	Model Compared	Probability	Decision	Selected Model
Chow Test	CEM vs FEM	0.0000	$p < 0.05$	FEM
Hausman Test	FEM vs REM	0.1607	$p > 0.05$	REM
Lagrange Multiplier Test	CEM vs REM	0.0000	$p < 0.05$	REM

Source: EViews 12 output, processed data, 2026.

Based on Table 3, the panel data regression model selection was carried out in stages using the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test. The Chow test results show a probability value of 0.0000, thus rejecting the null hypothesis. These results indicate that the Fixed Effect Model (FEM) is more appropriate than the Common Effect Model (CEM) because it is able to accommodate heterogeneity between districts/cities in Central Sulawesi Province. Furthermore, the Hausman test produces a probability value of 0.1607, or greater than the 5% significance level, so the null hypothesis is not rejected. This result indicates that individual effects are not systematically correlated with the independent variables, so the Random Effect Model (REM) is a more efficient estimator than the FEM.

These results are then reinforced by the Lagrange Multiplier (LM) test, which produces a probability value of 0.0000, so the REM is considered more appropriate than the CEM because there are significant random effects in the panel data structure. Based on this series of tests, the Random Effect Model (REM) estimated using the Estimated Generalized Least Squares (EGLS) method with the Swamy and Arora estimator was chosen as the final model in this study. This model selection procedure aligns with panel data analysis practices widely applied in poverty research at the regional level in Indonesia ([Sihombing & Arsani, 2021](#); [Wurarah et al., 2025](#)).

Table 4. Classical Assumption Test Results

Test	Method	Result	Decision
Normality	Jarque-Bera Test	Prob. = 0.3499	Residuals normally distributed
Multicollinearity	Variance Inflation Factor	All VIF < 10 $X_1 = 3.14$; $X_2 = 1.07$; $X_3 = 3.19$	No multicollinearity
Heteroscedasticity	Glejser Test	$X_1 = 0.9005$; $X_2 = 0.8001$; $X_3 = 0.5185$	No heteroscedasticity

Source: EViews 12 output, processed data, 2026.

Based on Table 4, the results of the classical assumption test indicate that the regression the model used has met the required basic assumptions and is therefore suitable for hypothesis testing. The normality test using the Jarque-Bera Test produces a probability value of 0.3499, which is greater than the 5% significance level, so the residuals can be declared normally distributed. Furthermore, the multicollinearity test using the Variance Inflation Factor (VIF) shows that all VIF values are below 10, namely 3.14 for the education variable, 1.07 for the unemployment variable, and 3.19 for the health variable. These results indicate that there are no symptoms of multicollinearity between the independent variables. Meanwhile, the heteroscedasticity test using the Glejser Test produces probability values of 0.9005 for the education variable, 0.8001 for the unemployment variable, and 0.5185 for the health variable.

All probability values are greater than 0.05, so it can be concluded that the model does not experience heteroscedasticity or has a homogeneous residual variance. With all these assumptions met, the Random Effect Model (REM), estimated using the Estimated Generalized Least Squares (EGLS) method with the Swamy and Arora estimator, is deemed suitable for estimating the influence of education, unemployment, and health on poverty levels in Central Sulawesi Province ([Nazamuddin et al., 2026](#); [Sihombing & Arsani, 2021](#)).

4.3 Regression Results

Table 5 presents the Random Effect Model estimation results for the relationship between education, unemployment, the Human Development Index, and poverty in Central Sulawesi during the 2017–2024 period.

Table 5. Random Effect Model Estimation Results

Variable	Coefficient	Expected Sign	Probability	Decision
Constant	75.446	—	—	—
Education (X_1)	-0.882	Negative	0.0341	Significant
Unemployment (X_2)	0.067	Positive	0.4667	Not significant
Health (X_3)	-0.799	Negative	0.0000	Significant
R-squared	0.6302	—	—	—
Adjusted R-squared	0.6191	—	—	—
F-statistic	56.8176	—	0.0000	Significant

Source: EViews 12 output, processed data, 2026.

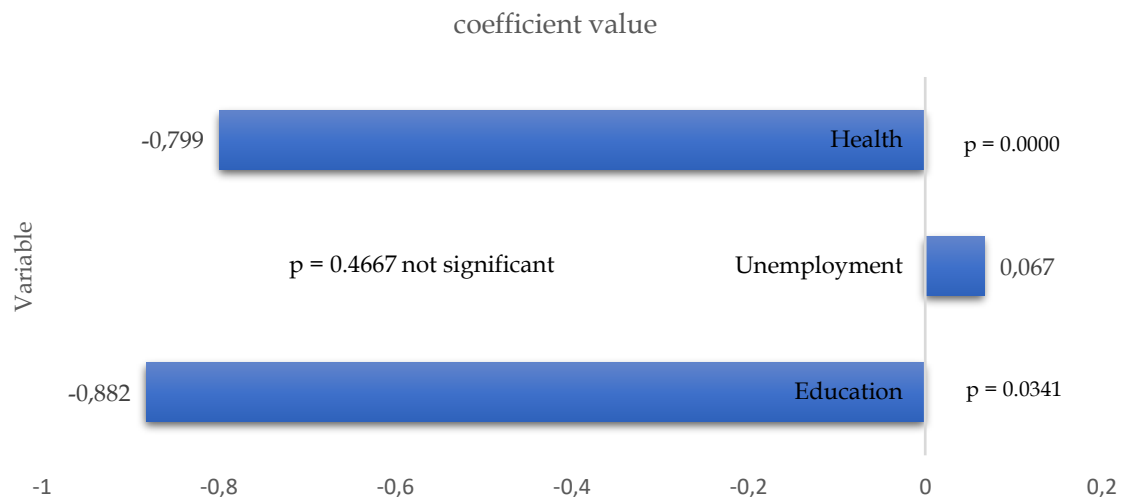
The estimated regression equation derived from the Random Effect Model is:

$$\hat{Y} = 75.446 - 0.882X_1 + 0.067X_2 - 0.799X_3 + \varepsilon$$

The constant of 75.446 represents the theoretical poverty rate when all explanatory variables are zero. Education has a negative and statistically significant coefficient (-0.882; $p = 0.0341$), indicating that an additional year of average schooling is associated with a 0.882 percentage point reduction in poverty, thereby supporting H1. Unemployment has a positive but statistically insignificant coefficient (0.067; $p = 0.4667$), indicating that higher unemployment is associated with higher poverty, although the effect is not statistically significant; therefore, H2 is rejected. Health, proxied by life expectancy, also shows a negative and statistically significant effect (-0.799; $p = 0.0000$), indicating that a one-year increase in life expectancy is associated with a 0.799 percentage point reduction in poverty, thus supporting H3.

Figure 3 provides a visual comparison of the estimated coefficients. Education and health exhibit negative relationships with poverty, whereas unemployment shows a positive relationship. Education has the largest absolute coefficient, followed by health, while unemployment has the smallest estimated effect.

Figure 3. Estimated Regression Coefficients of Education, Unemployment, and Health on Poverty



Note: Negative coefficients indicate an inverse relationship with poverty, while positive coefficients indicate a positive relationship with poverty. Statistical significance is based on the probability (p) values from the Random Effect Model.

Figure 3 shows that education and health have negative coefficients on poverty levels, while unemployment has a positive coefficient. Education has a coefficient of -0.882 and is statistically significant ($p = 0.0341$), indicating that an increase in average years of schooling is associated with a decrease in poverty levels. Health, proxied by life expectancy, also has a negative coefficient of -0.799 and is statistically significant ($p = 0.0000$), indicating that improvements in public health conditions are associated with a decrease in poverty levels. Conversely, unemployment has a positive coefficient of 0.067, indicating that increases in unemployment tend to be followed by increases in poverty levels. However, this relationship is not statistically significant ($p = 0.4667$). Overall, Figure 3 confirms the regression estimation results that education and health are negatively related to poverty, while unemployment is positively related. Among the three variables, education has the largest coefficient in absolute value, although health shows a stronger level of significance in the model.

Table 6. Robustness Check Using Year Fixed Effects

Variable	Coefficient	Probability	Decision
Education (X_1)	-0.186	0.6596	Rejected
Unemployment (X_2)	-0.011	0.8988	Rejected
Health (X_3)	-0.394	0.0338	Accepted
Adjusted R-squared	0.690	-	-
F-statistic	23.94	0.000	Accepted

Source: EViews 12 output, processed data, 2026

As a robustness check, the model was re-estimated by incorporating year fixed effects to control for common shocks affecting all regencies/cities during the 2017–2024 period, including the impact of the 2018 earthquake and the COVID-19 pandemic. The estimation results in Table 6 show that the health variable maintains a significant negative effect on poverty ($p = 0.0338$), whereas the relationship between education and poverty becomes statistically insignificant once time effects are controlled for. This shift in the significance of the education variable suggests that a portion of the relationship between education and poverty is linked to temporal changes occurring concurrently across all regions during the study period. Overall, these results indicate that the influence of health on poverty is relatively stronger than that of other variables when time factors are taken into account. The summary of hypothesis testing results is presented in Table 7 :

Table 7. Hypothesis Testing Summary

Hypothesis	Statement	Result	Decision
H1	Education has a significant negative effect on poverty	Negative and significant ($p = 0.0341$)	Accepted
H2	Unemployment has a significant positive effect on poverty	Positive but insignificant ($p = 0.4667$)	Rejected
H3	Health has a significant negative effect on poverty	Negative and significant ($p = 0.0000$)	Accepted
H4	Education, unemployment, and Health simultaneously affect poverty	Significant ($F = 56.8176$, $p = 0.0000$)	Accepted

Source: Processed from regression results, 2026.

4.4 Discussion of Empirical Findings

4.4.1 Education and Poverty (Accepted)

The results of the study indicate that education has a negative and significant effect on poverty levels. This finding supports the perspective of *Human Capital Theory*, which states that investment in education can increase individual productivity, expand employment opportunities, and increase household income, ultimately contributing to poverty reduction. In Central Sulawesi Province, the increase in average years of schooling indicates that the improving quality of human resources is beginning to translate into improved economic welfare at the district/city level. Although the regional economic structure is still dominated by the agriculture, fisheries, and mining sectors, improved education continues to provide benefits through improved workforce skills, adaptability to technological developments, and broader access to economic opportunities.

This finding aligns with research [Bahtia et al. \(2025\)](#) and [Imantria, \(2024\)](#), which shows that increasing education levels significantly reduces poverty by improving the quality of human resources and economic opportunities. These research findings are also consistent with [Muhlisin et al. \(2026\)](#), which states that educational development is a crucial factor in improving the quality of human capital and driving long-term regional economic growth. Furthermore, [Nursini et al. \(2026\)](#) explains that the effectiveness of education in reducing poverty will be greater if supported by increased workforce participation and more inclusive economic development. From the perspective of *Human Capital Theory*, education is an investment that increases an individual's knowledge, skills, and productivity, thereby generating higher incomes throughout their life cycle.

The results of this study are also in line with the *Capability Approach* proposed by Amartya Sen, who views education as a basic capability that expands individual freedom to achieve a more prosperous life and escape poverty. Meanwhile, from an Islamic economic perspective, the importance of education reflects the implementation of the principle of *hifz al-'aql* (maintenance of reason) as one of the main objectives of *maqashid al-shariah*. By improving knowledge and the quality of human resources, education not only increases economic productivity but also strengthens individuals' abilities to achieve sustainable prosperity in accordance with the goals of Islamic socio-economic development ([Chammearc & Ratnasih, 2023](#)).

4.4.2 Unemployment and Poverty (H2 Rejected)

The results show that the open unemployment rate has a positive coefficient, but it does not significantly influence the poverty rate in Central Sulawesi Province. This finding suggests that the open unemployment rate is not able to directly explain variations in poverty, reflecting the characteristics of the labor market in the region, which is still dominated by the informal sector. [Desanta and Aisyah, \(2025\)](#) also found that the open unemployment rate does not always have a consistent relationship with poverty because some people still earn income through informal economic activities. In Central Sulawesi Province, the majority of people work in agriculture, fisheries, small-scale trade, and various other informal economic activities. This condition allows households to continue earning income even if they do not work in the formal sector, so that an increase in the open unemployment rate is not always accompanied by an increase in poverty. This phenomenon was also seen during the COVID-

19 pandemic, when the impact of rising unemployment was relatively mitigated through government social protection, family support, and informal economic activities (Imantria, 2024; Pahrudin & Darminto, 2021). Although not statistically significant, the positive direction of the coefficient still indicates that increasing unemployment tends to increase the risk of poverty, in line with economic theory. Therefore, these results do not imply that employment opportunities are unimportant, but rather indicate that the open unemployment rate has limitations as an indicator of welfare in regions dominated by the informal sector (Febriani et al., 2026). These findings also show that improving the quality of human resources through education and health provides a more significant contribution to poverty reduction than changes in the open unemployment rate alone.

4.4.3 Health and Poverty (H3 Accepted)

The results of the study indicate that health, as measured by Life Expectancy (UHH), has a negative and significant effect on poverty levels in Central Sulawesi Province. This finding indicates that improving public health can reduce poverty by increasing labor productivity, the ability to earn income, and reducing household economic burdens due to health problems. Individuals with better health conditions tend to be able to work more productively and sustainably, thus having a greater chance of escaping poverty. This finding is in line with research Bahtia et al. (2025) which found that life expectancy has a negative and significant effect on poverty levels. Similar results were also shown by Samudra and Wahed (2023), and Hasanah et al. (2021), which stated that improving public health conditions contributes to poverty reduction by improving the quality of human resources and labor productivity.

The findings of this study are also supported by Wurarah et al. (2025) and Amate-Fortes et al. (2017) who emphasized that human development, particularly in the health aspect, is a crucial factor in improving societal welfare and reducing poverty, both regionally and internationally. Theoretically, these findings align with *Human Capital Theory*, which views health as an investment in human capital that can increase individual productivity and income. Furthermore, the *Capability Approach* proposed by Amartya Sen explains that health is a basic capability that enables a person to live a productive and prosperous life. From an Islamic economic perspective, these findings reflect the implementation of the principle of *hifz al-nafs* (preservation of the soul) as one of the main objectives of *maqashid al-shariah*. Therefore, improving health quality not only contributes to individual well-being but also serves as an important instrument in supporting sustainable poverty alleviation (Nazamuddin et al., 2026; Rizkiawan et al., 2025).

4.4.4 Simultaneous Effects (H4 Accepted)

The results of the simultaneous test indicate that the overall regression model is significant, as indicated by the F-statistic value of 56.817 with a probability of 0.0000 (<0.05). In addition, the Adjusted R^2 value of 0.619 indicates that approximately 61.9% of the variation in poverty levels in Central Sulawesi Province can be explained by education, unemployment, and health, while the remainder is influenced by other factors outside the model. These results indicate that the three variables together have a significant effect on poverty levels, although unemployment does not have a significant partial effect. This condition indicates that poverty is a multidimensional problem influenced by the interaction of various aspects of human development and labour market conditions. This finding is in line with Rizkiawan et al. (2025), which states that poverty reduction is more effectively achieved through integrated

human development than through interventions in one sector alone. This result is also supported by [Febriani et al. \(2026\)](#), which explains that poverty is influenced by the simultaneous interaction of various economic and human development factors. Therefore, poverty alleviation efforts in Central Sulawesi Province need to be implemented through integrated policies that improve the quality of education, public health, and expand employment opportunities.

4.5 Islamic Economics Interpretation

The interpretation of the findings from an Islamic economics perspective is presented in Table 8

Table 8. Interpretation of Findings from an Islamic Economics Perspective

Empirical Finding	Islamic Economics Interpretation	Maqashid Dimension
Education significantly reduces poverty	Schooling must be linked to skills, productivity, and recognized work (<i>kasb halal</i>) to fulfill <i>hifz al-'aql</i>	<i>Hifz al-'aql</i>
Health significantly reduces poverty	Better health reflects the fulfillment of <i>hifz al-nafs</i> , enabling individuals to work productively and improve their welfare.	<i>Hifz al-'nafs</i>
Unemployment is positive but insignificant.	Work access is an Islamic obligation; Poverty is also mediated by family solidarity (<i>ta'awun</i>) and informal income.	<i>Hifz al-mal</i>
Variables jointly affect poverty.	Poverty eradication requires integrated social, economic, and moral policies; no single instrument suffices.	Integrated <i>maqashid</i>

Source: Authors' interpretation based on regression results and maqashid al-shariah framework.

From an Islamic economics perspective, the findings of this study have normative implications that extend beyond statistical relationships. Poverty is viewed not only as insufficient income but also as a condition that prevents the realization of maqashid al-shariah, including the protection of religion (*hifz al-din*), life (*hifz al-nafs*), intellect (*hifz al-'aql*), lineage (*hifz al-nasl*), and wealth (*hifz al-mal*) ([Musaddad et al., 2025](#); [Tumewang et al., 2025](#)). In this study, maqashid al-shariah functions as an interpretive framework rather than an empirically tested variable. Education, health, and employment opportunities correspond respectively to *hifz al-'aql*, *hifz al-nafs*, and *hifz al-mal*, indicating that the three explanatory variables collectively reflect dimensions of human development consistent with Islamic objectives ([Fatoni et al., 2019](#); [Isa et al., 2023](#)). Meanwhile, education reflects efforts to maintain reason (*hifz al-'aql*), while employment opportunities are related to the protection of wealth (*hifz al-mal*). Thus, the three variables in this study collectively reflect human development that aligns with the objectives of *maqashid al-shariah* ([Riani & Indra, 2026](#)).

The negative and significant effect of education suggests that improving educational quality is an important instrument for poverty reduction. From the Islamic perspective, education represents *hifz al-'aql* and supports the development of knowledge, skills, and moral values, consistent with the concept of *insan kamil* ([Suliswanto et al., 2025](#)). Health also shows a negative and significant relationship with poverty, reinforcing the principle of *hifz al-nafs*, whereby better health enhances productivity, income opportunities, and household welfare ([Cipta et al., 2026](#); [Musaddad et al., 2025](#)).

Although unemployment is not statistically significant, employment remains central to *hifz al-mal* because it enables the acquisition of lawful income. In economies dominated by the informal sector, the poverty impact of unemployment may be moderated by Islamic social solidarity mechanisms such as *zakat*, *infaq*, *sadaqah*, *waqf*, *ta'awun*, and family support (Novreska & Arundina, 2024). This interpretation is supported by Riani and Indra (2026), who show that Islamic social finance can reduce poverty in communities with high economic informality.

The significant joint effect of education, unemployment, and health supports the Islamic principle that poverty reduction requires integrated interventions across human development and social solidarity (Fatoni et al., 2019; Musaddad et al., 2025). Accordingly, Islamic social finance instruments should be directed not only toward consumption support but also toward strengthening educational quality, health services, and income-generating skills in the most disadvantaged districts of Central Sulawesi, particularly Donggala, Tojo Una-Una, Parigi Moutong, and Poso (Abdullah Thaidi et al., 2024).

Synthesis

Overall, the empirical results of this study show a clear conclusion and have important implications for policy formulation, namely that education and health are the two main factors that play a role in reducing poverty levels in 13 districts/cities in Central Sulawesi Province during the 2017–2024 period, while the open unemployment rate does not show a significant effect partially. The significant influence of education and health indicates that improving the quality of human resources through better education and higher health levels has a greater role in reducing poverty than labor market conditions alone. However, the positive unemployment coefficient indicates that the provision of employment opportunities remains an important supporting factor in improving community welfare. Therefore, poverty alleviation efforts require integrated policies through improving the quality of education, expanding access to health services, and creating productive employment opportunities. From an Islamic economic perspective, these findings emphasize the importance of realizing the objectives of *maqashid al-shariah*, especially *hifz al-'aql*, *hifz al-nafs*, and *hifz al-mal*, through sustainable investment in education, health, and inclusive economic development, and supported by the strategic use of Islamic social finance instruments to improve community welfare and reduce poverty in Central Sulawesi Province.

5. Conclusion and Suggestion

This study demonstrates that poverty in Central Sulawesi cannot be explained by a single socioeconomic factor but is shaped by the interaction of human capital and labor market conditions. The empirical findings indicate that strengthening human capital, particularly through improvements in education and health, provides a more effective pathway for poverty reduction than relying solely on labor market indicators. These results reinforce the importance of adopting an integrated poverty alleviation strategy that combines investments in education, healthcare, and productive economic opportunities. From the perspective of Islamic economics, this integrated approach is consistent with the objectives of *maqashid al-shariah*, particularly the realization of *hifz al-'aql*, *hifz al-nafs*, and *hifz al-mal*, as the foundation for achieving sustainable social welfare.

Accordingly, poverty reduction policies in Central Sulawesi should not only prioritise expanding access to quality education and healthcare but also strengthen productive employment opportunities that correspond to local economic potential. In addition, Islamic social finance instruments, including zakat, infaq, sadaqah, and productive waqf, should be optimised to complement government programmes in improving human welfare and reducing poverty. Future research is recommended to incorporate broader socioeconomic variables, such as economic growth, government expenditure, income inequality, infrastructure, Islamic social finance, and sectoral employment, to provide a more comprehensive understanding of poverty dynamics in Central Sulawesi.

6. Limitations and Future Research

This study has several limitations. First, it uses secondary data from 13 districts and cities in Central Sulawesi Province during 2017–2024, resulting in 104 panel observations. Although sufficient for district-level panel analysis, this dataset may not fully capture long-term structural changes in poverty related to post-disaster recovery, post-pandemic adjustment, and regional economic transformation. Second, the model includes only education, unemployment, and health (proxied by life expectancy), whereas poverty is also influenced by factors such as economic growth, government expenditure, income inequality, infrastructure, employment structure, investment, social protection, and Islamic social finance. In addition, education is measured only by average years of schooling and health by life expectancy, which do not fully capture educational quality, labor market relevance, healthcare access, or healthcare quality across districts. Therefore, the findings should be interpreted within the district-level context of Central Sulawesi and should not be generalized to other regions without further empirical evidence.

Future research is recommended to extend the observation period, add more diverse explanatory variables, and conduct comparative analyses with other provinces with similar socioeconomic characteristics. Furthermore, future research could employ a more comprehensive econometric approach, such as a dynamic panel model or a spatial econometric model, to better capture the temporal dynamics and spatial interrelationships of poverty. From an Islamic economics perspective, future research is also recommended to include variables such as zakat, infaq, sedekah, waqf, Islamic financial inclusion, and Sharia-based community empowerment programmes to examine the contribution of Islamic social finance to poverty reduction. Furthermore, the use of a mixed methods approach that combines quantitative analysis with interviews or field studies, particularly in districts with relatively high poverty rates such as Donggala, Tojo Una-Una, Parigi Moutong, and Poso, will provide a deeper understanding of the socioeconomic conditions of the community, household vulnerability, and the effectiveness of poverty alleviation policy implementation.

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Declaration of Artificial Intelligence (AI) and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT by OpenAI to assist with language refinement, academic writing improvement, grammar checking, and manuscript structuring. After using this tool, the authors carefully reviewed, verified, and edited the content as necessary and took full responsibility for the accuracy, integrity, and final content of the publication.

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