



Research Paper

The Effect of Education Level and Health Level on Income Distribution Inequality in the Regencies/Cities of Aceh Province

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Abstract

This study analyzes the effect of education level and health level on income distribution inequality in the 23 regencies/cities of Aceh Province, Indonesia, over the period 2019–2023. The independent variables are education level (X1), measured by mean years of schooling, and health level (X2), measured by life expectancy, while the dependent variable is income distribution inequality (Y), measured by the Gini ratio. The study used a quantitative approach with panel data regression combining time-series and cross-sectional data (115 observations) obtained from Statistics Indonesia (BPS) of Aceh Province. The best model was selected using the Chow, Hausman, and Lagrange Multiplier tests, which indicated that the Common Effect Model is the most appropriate model. The results show that education level has a negative and significant effect on income distribution inequality (coefficient -0.012104 ; $p = 0.0000$), and health level also has a negative and significant effect (coefficient -0.006424 ; $p = 0.0000$). Simultaneously, the two variables have a significant effect on income distribution inequality (F-statistic 99.11681 ; $p = 0.0000$). The coefficient of determination (R^2) is 0.638982 , meaning that education level and health level explain about 63.9% of the variation in income distribution inequality, while the remaining 36.1% is explained by other factors outside the model, such as unemployment, economic growth, infrastructure, and government policy. The study recommends expanding access to education and improving the quality and distribution of health services across regencies/cities in Aceh.

Keywords: Education Level, Health Level, Income Distribution Inequality, Gini Ratio, Panel Data

1. Introduction

As a developing country, Indonesia still faces various economic challenges, including high poverty and unemployment rates, slow economic growth, unequal income distribution, and



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limited employment opportunities. Despite continued economic growth, development in Indonesia has not fully addressed poverty, unemployment, and widening income inequality. Inequality occurs in almost all developing countries, and developed countries are no exception; it affects economic activity and prosperity across regions [1], [2]. Cross-country evidence shows that inequality and poverty are closely linked to growth [3], and that growth benefits the poor less when inequality is high [4].

Income distribution refers to how income is distributed among individuals or households in a society. Income distribution inequality refers to differences in the income received by different individuals, leading to a gap between upper- and lower-income groups, which can cause social problems and economic instability [5], [6]. Inequality is commonly measured using the Gini ratio, which ranges from zero to one: a value close to zero indicates that income is evenly distributed, while a value close to one indicates that income is highly unequally distributed [7]. The Gini ratio varies across provinces and regencies/cities in Indonesia, which affects people's welfare.

Education and health are two key components of human capital that can affect income distribution. Education improves skills, productivity, and earning capacity, and a more equal distribution of education tends to reduce income inequality [8], [9]. Health enables people to work productively and for longer periods, and poor health limits the ability to earn income [10], [11]. However, empirical studies in Indonesia have produced mixed results: some found that education reduces inequality [6], while others found a positive effect [5]. Studies in Aceh have focused mainly on the effects of education and health on poverty [12] or on the effects of fiscal and demographic factors on inequality [1], [2], [13], while studies that examine the effects of both education and health on income inequality across all regencies/cities in Aceh remain limited. This study therefore aims to analyze the effect of education level and health level on income distribution inequality in the 23 regencies/cities of Aceh Province in 2019–2023.

2. Literature Review

Income Distribution Inequality

Income distribution inequality is the difference in income received by members of a society, resulting in a significant gap in income levels between social groups [5]. Inequality can be measured in absolute terms or in relative terms, by comparing the income received by an individual or group with the total income of the community. The Gini ratio is the most commonly used measure of income inequality and is published by BPS at the national, provincial, and regency/city levels [7]. In Aceh, income inequality has been found to be influenced by population, fiscal transfers, unemployment, and human development [1], [2].

Education Level

Education improves a person's skills, productivity, and ability to earn an income. The higher the level of education, the greater the chance of finding decent work and earning a better income. A meta-regression analysis found that education reduces the income share of top earners and increases the share of bottom earners [8], and cross-country evidence shows that a more equal distribution of educational attainment lowers income inequality [9]. However, the effect of average years of schooling on inequality can be small or even positive when access to and the quality of education are unequal [5], [14]. Education is commonly measured by mean years of schooling [15].

Health Level

Health is a state of physical, mental, and social well-being that enables people to live productively. People with better health are more productive, have lower absenteeism, and can work for longer periods, which increases their income and contributes to a more even distribution

of income [15], [16]. Conversely, poor health limits a person's ability to work and reduces income, so that people in poor health tend to be trapped in poverty while healthy groups expand their economic advantages [12]. The relationship between income inequality and health is bidirectional, as inequality also affects population health [10], [11]. Health is commonly measured by life expectancy [15].

Hypotheses

Based on the theory and previous studies, the hypotheses of this study are as follows: H1, education level has a negative and significant effect on income distribution inequality in the regencies/cities of Aceh Province; H2, health level has a negative and significant effect on income distribution inequality in the regencies/cities of Aceh Province; and H3, education level and health level simultaneously have a significant effect on income distribution inequality in the regencies/cities of Aceh Province.

3. Method

Research Approach and Data

This study used a quantitative approach with panel data. The research covered the 23 regencies/cities in Aceh Province over the period 2019–2023, giving 115 observations. The data were obtained from publications of Statistics Indonesia (BPS) of Aceh Province [7]. Income distribution inequality (Y) is measured by the Gini ratio, education level (X1) by mean years of schooling (years), and health level (X2) by life expectancy at birth (years).

Data Analysis

The data were analyzed using panel data regression with the following equation:

$$Y_{it} = \alpha + \beta_1 X1_{it} + \beta_2 X2_{it} + \varepsilon_{it}$$

where Y is income distribution inequality, α is the constant, β_1 and β_2 are the regression coefficients, X1 is education level, X2 is health level, ε is the error term, i denotes the regency/city, and t denotes the year. The model was estimated using the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM), and the best model was selected using the Chow test (CEM vs. FEM), the Hausman test (REM vs. FEM), and the Lagrange Multiplier test (CEM vs. REM) [17], [18]. The hypotheses were then tested using t-tests (partial) and an F-test (simultaneous) at a 5% significance level.

4. Result and Discussion

Descriptive Statistics

The descriptive statistics of the variables are presented in Table 1.

Table 1. Descriptive statistics

Statistic	Gini ratio (Y)	Education level (X1)	Health level (X2)
Mean	0.277304	9.690261	68.52183
Median	0.280000	9.320000	68.94000
Maximum	0.350000	13.04000	72.79000
Minimum	0.210000	7.580000	63.72000
Std. deviation	0.036354	1.299876	2.456985
Observations	115	115	115

Source: Data processed with EViews, 2024.

The Gini ratio has a mean of 0.277304, a maximum of 0.350000, a minimum of 0.210000, and a standard deviation of 0.036354, indicating low to moderate inequality across regencies/cities in Aceh. Education level has a mean of 9.690261 years, with a maximum of 13.04000 and a minimum of 7.580000 years. Health level has a mean of 68.52183 years, with a maximum of 72.79000 and a minimum of 63.72000 years.

Panel Data Regression Estimates

The estimation results of the three panel data models are summarized in Table 2.

Table 2. Estimation results of the CEM, FEM, and REM

Variable	CEM	FEM	REM
Constant	0.834780 (12.394)	0.752572 (10.316)	0.823573 (12.456)
Education level (X1)	-0.012104 (-5.442)	-0.012318 (-4.827)	-0.012192 (-5.546)
Health level (X2)	-0.006424 (-5.459)	-0.005194 (-4.160)	-0.006248 (-5.422)
R ²	0.638982	0.729978	0.627550
F-statistic	99.11681	10.13776	94.35556
Prob(F-statistic)	0.000000	0.000000	0.000000

Note: t-statistics in parentheses; all coefficients are significant at the 1% level. R² for the REM is the weighted R². Source: Data processed with EViews, 2024.

In all three models, education level and health level have negative coefficients with probability values below 0.05, so the direction and significance of the results are consistent across specifications.

Selection of the Best Model

The results of the model selection tests are presented in Table 3.

Table 3. Results of the model selection tests

Test	Statistic	Prob.	Selected model
Chow test (cross-section F)	1.378620 (22; 90)	0.1473	CEM
Hausman test (chi-square)	5.328700 (2)	0.0696	REM
Lagrange Multiplier test (Honda, cross-section)	0.763946	0.2224	CEM

Note: degrees of freedom in parentheses. Source: Data processed with EViews, 2024.

The Chow test probability (0.1473) is greater than 0.05, so the CEM is preferred to the FEM. The Hausman test probability (0.0696) is greater than 0.05, so the REM is preferred to the FEM. The Lagrange Multiplier test probability (0.2224) is greater than 0.05, so the CEM is preferred to the REM. The low share of cross-sectional variance in the REM ($\rho = 0.0399$) also indicates that regency/city-specific effects are small. Therefore, the Common Effect Model is the best model for this study [17], [18].

Common Effect Model and Hypothesis Testing

The results of the selected Common Effect Model are presented in Table 4.

Table 4. Results of the Common Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.834780	0.067353	12.39419	0.0000
Education level (X1)	-0.012104	0.002224	-5.441970	0.0000
Health level (X2)	-0.006424	0.001177	-5.459126	0.0000
R ²	0.638982		Adjusted R ²	0.632535
F-statistic	99.11681		Prob(F-statistic)	0.000000
Durbin-Watson stat.	1.759484			

Source: Data processed with EViews, 2024.

Based on Table 4, the panel regression equation is as follows:

$$Y_{it} = 0.834780 - 0.012104X1_{it} - 0.006424X2_{it} + \varepsilon_{it}$$

The F-statistic is 99.11681 with a probability of $0.000000 < 0.05$; thus, H_0 is rejected, meaning that education level and health level simultaneously have a significant effect on income distribution inequality in the regencies/cities of Aceh Province (H_3 accepted). The R^2 of 0.638982 indicates that the two variables explain about 63.9% of the variation in income distribution inequality, while the remaining 36.1% is explained by other variables outside the model. Partially, education level has a coefficient of -0.012104 and a t-statistic of -5.441970 ($p = 0.0000$), and health level has a coefficient of -0.006424 and a t-statistic of -5.459126 ($p = 0.0000$), so both variables have a negative and significant effect on income distribution inequality (H_1 and H_2 accepted).

Effect of Education Level on Income Distribution Inequality

Education level has a negative and significant effect on income distribution inequality, with a coefficient of -0.012104. This means that an increase of one year in mean years of schooling is associated with a decrease in the Gini ratio of 0.0121 points, assuming health level is constant. This finding is consistent with Hindun *et al.* [6], who found that education significantly affects income inequality in Indonesia, and with cross-country evidence that education reduces the income share of top earners and increases the share of bottom earners [8] and that a more equal distribution of education lowers income inequality [9]. Education increases the skills and productivity of lower-income groups, allowing them to obtain better jobs and higher incomes and thus narrowing the income gap. This finding differs, however, from Nadya and Syafri [5], who found a positive effect of education on inequality across Indonesian provinces, and from Coady and Dizioli [14], who found that the link between average schooling and inequality is small and sometimes positive. These differences suggest that the equalizing effect of education depends on how evenly access to and the quality of education are distributed.

Effect of Health Level on Income Distribution Inequality

Health level has a negative and significant effect on income distribution inequality, with a coefficient of -0.006424. This means that an increase of one year in life expectancy is associated with a decrease in the Gini ratio of 0.0064 points, assuming education level is constant. This finding is consistent with Annisa and Anwar [12], who found that health significantly reduces poverty in Aceh, and with Sitorus *et al.* [15], who found that life expectancy significantly increases GRDP per capita in Indonesia. A healthier population is more productive and can work for longer periods, which increases the income of lower-income groups and leads to a more even distribution of income. At the same time, the relationship between health and inequality runs in both directions, as greater inequality also worsens population health [10], [11], so improvements in health and reductions in inequality can reinforce each other. Because government spending on education and

health in Aceh has not yet been found to significantly raise human development [19], the effectiveness of this spending in reaching lower-income groups needs to be improved.

Limitations

This study has several limitations. It uses only two explanatory variables and a relatively short period (2019–2023), which includes the COVID-19 pandemic, so other determinants of inequality, such as unemployment, economic growth, infrastructure, and fiscal transfers, are not captured. The selected Common Effect Model does not account for unobserved regency/city characteristics, and diagnostic tests for multicollinearity and heteroscedasticity were not reported [20]. Because education and health are closely related, their individual effects should be interpreted with caution.

5. Conclusion

Income distribution inequality in the regencies/cities of Aceh Province in 2019–2023 is significantly influenced by education level and health level, based on the Common Effect Model. Education level has a negative and significant effect on income distribution inequality (coefficient -0.012104 ; $p = 0.0000$), and health level also has a negative and significant effect (coefficient -0.006424 ; $p = 0.0000$). Simultaneously, the two variables have a significant effect (F-statistic 99.11681 ; $p = 0.0000$) and explain about 63.9% of the variation in income distribution inequality.

The government is advised to expand access to education, especially in rural and underdeveloped areas, by developing educational facilities and infrastructure, improving teacher quality, and providing scholarships for low-income communities. The government is also advised to improve the quality of health services by strengthening basic health facilities, such as community health centers, clinics, and hospitals, and by distributing medical personnel more equally across regencies/cities. Future research should include other determinants of inequality, such as unemployment, economic growth, and fiscal transfers, and use a longer period.

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Authors' contributions and responsibilities

Agnes: conceptualization, data collection, formal analysis, writing – original draft. Yuliana: supervision, methodology, writing – review & editing. Edi Saputra: supervision, validation, writing – review & editing.

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Availability of data and materials

The data used in this study are secondary data published by Statistics Indonesia (BPS) of Aceh Province and are publicly available. The processed data are available from the authors upon reasonable request.

Competing interests

The authors declare no competing interest.

Ethical approval

Not applicable. This study used publicly available secondary data and did not involve human participants.

Additional information

No additional information from the authors.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this manuscript, Claude (Anthropic) was used to improve the language and readability of the English text and to format the manuscript, tables, equations, and references according to the journal template. The tool was not used to generate research data, perform the analysis, or draw conclusions. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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