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Local government health expenditure and life expectancy: cross-regency evidence from West Kalimantan, Indonesia

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ABSTRACT

While subnational health spending in Indonesia has expanded under fiscal decentralisation, stark disparities in life expectancy persist across regions, raising questions about whether larger budgets translate into better population health. Grounded in the health production function and capability approach, this study examines the effect of local government health expenditure on life expectancy at birth across all 14 regencies and municipalities in West Kalimantan Province and tests whether this relationship holds after accounting for regional poverty. Using 2023 cross-sectional data from Statistics Indonesia (BPS) and the Directorate General of Fiscal Balance (DJPK), we estimate log-linear regression models via Ordinary Least Squares (OLS) with MacKinnon-White-Davidson (HC3) heteroskedasticity-robust standard errors, complemented by outlier sensitivity checks. In the baseline specification, health expenditure exhibits a positive and statistically significant association with life expectancy ($\beta = 2.936, p = 0.003$; HC3 $p = 0.005$), explaining 53.1% of cross-regional variation; a 10% increase in spending corresponds to approximately 0.28 additional years of life expectancy. However, once the regional poverty rate is controlled for, the health expenditure coefficient drops by 72% ($\beta = 0.831$) and loses statistical significance ($p = 0.143$; HC3 $p = 0.135$), whereas poverty exerts a strong negative effect ($\beta = -0.574, p = 0.001$) and raises the model's explanatory power to 89.3%. These findings demonstrate that nominal budget size is not an autonomous determinant of longevity when socioeconomic deprivation constrains households' capability to access and benefit from public health services. Local governments should shift from input-based budgeting toward performance-based allocations targeting primary and promotive-preventive care in high-poverty inland regencies, supported by needs-based provincial fiscal transfers.

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Introduction

Human development is the ultimate goal of the development process. Since 1990, the United Nations Development Programme (UNDP) has emphasised that development extends beyond income growth to encompass people's opportunities to lead long and healthy lives, acquire knowledge, and achieve a decent standard of living (UNDP, 2024). Among these dimensions, health, measured by life expectancy at birth, is fundamental because it supports educational participation, economic productivity, and overall well-being (Sen, 1999). Understanding the determinants of life expectancy is therefore essential for assessing the effectiveness of public development policies.

Under fiscal decentralisation, local governments can improve population health through health-function expenditure in regional budgets (*Anggaran Pendapatan dan Belanja Daerah*, APBD). Their responsibilities include operating community health centres (*puskesmas*), providing health personnel, and implementing preventive programmes. Theoretically, public health expenditure constitutes an investment in health capital (Grossman, 1972). This relationship is reflected in the health production function, which links health outcomes to health expenditure and socio-economic conditions, including income, education, and the environment (Fayissa & Gutema, 2005). However, diminishing marginal returns may limit the benefits of additional spending (Nixon & Ulmann, 2006).

The effectiveness of public health expenditure also depends on socio-economic deprivation. The capability approach defines poverty as a deprivation of substantive freedoms, including the ability to achieve good health, rather than merely insufficient income (Sen, 1999). Anand & Ravallion (1993) similarly demonstrate that population health depends on both household income and public health provision. Consequently, greater health expenditure may not improve life expectancy substantially when poor households face barriers such as undernutrition, inadequate sanitation, transportation costs, and limited health literacy. Poverty may thus constrain the conversion of public resources into improved health outcomes.

Empirical evidence on the relationship between health expenditure and health outcomes remains mixed. Public spending has been associated with lower infant and under-five mortality in developing countries (Bokhari et al., 2007) and higher life expectancy across SAARC–ASEAN (Rahman et al., 2018), MENA (Balkhi et al., 2021), European Union (Onofrei et al., 2021), and OECD countries (Anwar et al., 2023). It may also strengthen the contribution of fiscal decentralisation to subnational human development (Miranda-Lescano et al., 2022). Conversely, Filmer and Pritchett (1999) find that socio-economic and cultural factors explain most cross-country variation in child mortality. Subsequent studies highlight the importance of primary care allocation and governance quality in determining spending effectiveness (Farag et al., 2013; Gupta et al., 2002; Rajkumar & Swaroop, 2008).

These issues are particularly relevant to West Kalimantan Province, an Indonesian border region with a vast territory and uneven population distribution. In 2023, its Human Development Index (HDI) reached 70.47, below the national average (BPS, 2026). Life expectancy also varied considerably, from 73.84 years in Pontianak City to 66.83 years in North Kayong Regency. Fiscal disparities reveal a similar puzzle: Ketapang Regency allocated IDR 356.41 billion to health, the province's second-largest local allocation, yet its life expectancy was 70.31 years, below that of Singkawang City despite the latter's substantially smaller health budget. These differences raise questions about the effectiveness of local health expenditure and the role of poverty in shaping health outcomes.

Despite these disparities, Indonesian studies have generally examined human development at the provincial level or used the composite HDI as the dependent variable,

leaving the relationship between local health expenditure and life expectancy relatively underexplored (Paramita et al., 2020). Evidence on whether this relationship persists after accounting for regional poverty also remains limited. Accordingly, this study addresses two research questions: (1) Is local government health expenditure positively associated with life expectancy at birth across West Kalimantan's regencies and municipalities? and (2) Does this relationship remain robust after controlling for regional poverty? Based on the health capital and health production frameworks, the study hypothesises that health expenditure is positively associated with life expectancy, although the strength and statistical significance of this relationship may change after poverty is considered.

This study aims to analyse the relationship between local government health expenditure and life expectancy at birth across all 14 regencies and municipalities of West Kalimantan in 2023 and assess its robustness after controlling for regional poverty. It contributes to the literature in three ways: providing subnational evidence from an understudied Indonesian border province; examining the robustness of the fiscal–health relationship after accounting for socio-economic deprivation; and offering policy insights into performance-oriented and pro-poor health budgeting. The findings are expected to support more effective allocation of regional resources to improve population health.

Method

This is a quantitative explanatory study that tests relationships between variables through hypothesis testing. The unit of analysis is all 14 regencies and municipalities of West Kalimantan Province in 2023 (a full census of regions), giving 14 observations. Life expectancy and poverty data were obtained from BPS-Statistics of West Kalimantan Province, while realised health-function expenditure was obtained from the Directorate General of Fiscal Balance (DJPK), Ministry of Finance (BPS, 2024; DJPK, 2024). The operational definitions of the variables are presented in table 1.

Table 1. Operational definitions of variables.

Variable	Definition	Unit	Source
Life expectancy (LE)	Expected years of life at birth under prevailing mortality patterns	Years	BPS-Statistics West Kalimantan
Health expenditure (HE)	Realised regency/municipal spending on the health function in the APBD	IDR billion	DJPK, Ministry of Finance
Poverty rate (POV)	Share of population with per capita expenditure below the poverty line	Percent	BPS-Statistics West Kalimantan

Following the log-linear health production function (Fayissa & Gutema, 2005), the main model is specified as in equation (1):

$$LE_i = \alpha + \beta\ ln(HE_i) + \varepsilon_i \quad (1)$$

where $LE_i$is life expectancy in regency/municipality i, $ln(HE_i)$ is the natural logarithm of health expenditure, α is the constant, β is the regression coefficient, and ε_i is the error term. The logarithmic transformation captures diminishing marginal returns and reduces the skewness of the spending distribution; $\beta/100$ is interpreted as the change in life expectancy (years) associated with a 1 percent increase in health expenditure. To test

whether the effect of health expenditure persists after accounting for regional socio-economic conditions, the robustness model in equation (2) adds the poverty rate as a control variable:

$$LE_i = \alpha + \beta_1 \, ln(HE_i) + \beta_2 \, POV_i + \varepsilon_i \quad (2)$$

Both models are estimated by Ordinary Least Squares (OLS). Given the small sample, inference is also reported using HC3 heteroskedasticity-consistent standard errors, which are recommended for small samples (Long & Ervin, 2000). The classical assumption tests comprise residual normality (Jarque-Bera and Shapiro-Wilk), heteroskedasticity (Breusch-Pagan and Glejser), autocorrelation (Durbin-Watson), multicollinearity (VIF) for Model 2, and the Ramsey RESET specification test (Gujarati & Porter, 2009). Influential observations are examined using Cook's distance. Hypotheses are tested using the t-test, F-test, and coefficient of determination (R^2) at the 5 percent significance level.

Results and Discussion

1. Results

a. Descriptive statistics

Table 2 presents the descriptive statistics. Mean life expectancy across the 14 regions is 69.35 years, ranging from 66.83 years (Kayong Utara Regency) to 73.84 years (Pontianak City). Mean health expenditure is IDR 213.31 billion, but its variation is very wide: spending in Pontianak City (IDR 450.24 billion) is more than five times that of Kayong Utara Regency (IDR 87.65 billion). The right-skewed spending distribution (skewness 0.93) supports the logarithmic transformation. The mean poverty rate is 9.01 percent, ranging from 4.12 to 13.45 percent.

Table 2. Descriptive statistics of research variables.

Variable	Mean	Median	Std. dev.	Min.	Max.
LE	69.349	69.045	1.967	66.830	73.840
HE	213.311	186.485	104.949	87.650	450.240
POV	9.009	8.940	2.731	4.120	13.450

Source: BPS & DJPK, processed by the authors

b. Classical assumption tests

The results in table 3 show that the main model satisfies the classical linear regression assumptions. Residuals are normally distributed (Jarque-Bera p = 0.693; Shapiro-Wilk p = 0.784). There is no heteroskedasticity according to either the Breusch-Pagan (p = 0.376) or Glejser (p = 0.235) test. The Durbin-Watson statistic of 1.431 lies between d_U = 1.350 and 4 − d_U = 2.650 (n = 14, k = 1), indicating no autocorrelation. The Ramsey RESET test (p = 0.203) indicates that the log-linear functional form is appropriate. In Model 2, a VIF of 1.755 (< 10) indicates no serious multicollinearity.

Table 3. Classical assumption test results.

Test	Statistics (Model 1)	p-value (Model 1)	Statistics (Model 1)	p-value (Model 1)	Conclusion
Jarque-Bera	0.733	0.693	1.096	0.578	Normal
Shapiro-Wilk	W = 0.964	0.784	W = 0.934	0.347	Normal
Breusch-Pagan	0.784	0.376	0.308	0.857	Homoskedastic
Glejser (ln HE)	–	0.235	–	0.425	Homoskedastic

Durbin-Watson	1.431	–	1.641	–	No autocorrelation
Ramsey RESET	F = 1.882	0.203	F = 3.202	0.089	Correct specification
VIF	–	–	1.755	–	No multicollinearity

Source: BPS & DJPK, processed by the authors

c. Estimation results and hypothesis testing

The estimation results of the main model (Model 1) and the robustness model (Model 2) are presented in table 4.

Table 4. OLS estimation results.

Variable	Model 1 coefficient	Robust SE (HC3)	p-value	Model 2 coefficient	Robust SE (HC3)	p-value
Constant	53.924***	4.329	0.000	70.150***	3.148	0.000
ln(HE)	2.936***	0.860	0.005	0.831	0.515	0.135
POV	–	–	–	−0.574***	0.123	0.001
R^2	0.531			0.893		
Adjusted R^2	0.492			0.873		
F-statistic	13.586***		0.003	45.706***		0.000
t-test	t = 3.686		0.003	t = 1.576		0.143

Source: BPS & DJPK, processed by the authors

The Model 1 regression equation is LE_i = 53.924 + 2.936 $ln(HE_i)$. The coefficient of $ln(HE_i)$ is positive and significant, with a t-statistic of 3.686 exceeding the critical t-value of 2.179 (df = 12; α = 5%) and a p-value of 0.003. The result remains significant with HC3 robust standard errors (p = 0.005). Therefore, H_1 is accepted: local government health expenditure has a positive and significant effect on life expectancy in the regencies and municipalities of West Kalimantan.

Substantively, a coefficient of 2.936 means that a 1 percent increase in health expenditure is associated with life expectancy higher by about 0.029 years. A 10 percent increase corresponds to roughly 0.28 additional years (about 3.4 months), while a doubling of spending is associated with a difference of about 2.04 years. The F-statistic of 13.586 exceeds the critical F-value of 4.747 (p = 0.003), so the model is adequate. The R^2 of 0.531 indicates that variation in health expenditure explains 53.1 percent of the cross-regional variation in life expectancy, while the remaining 46.9 percent is explained by factors outside the model. Figure 1 shows this positive relationship together with the deviation of several regions from the regression line.

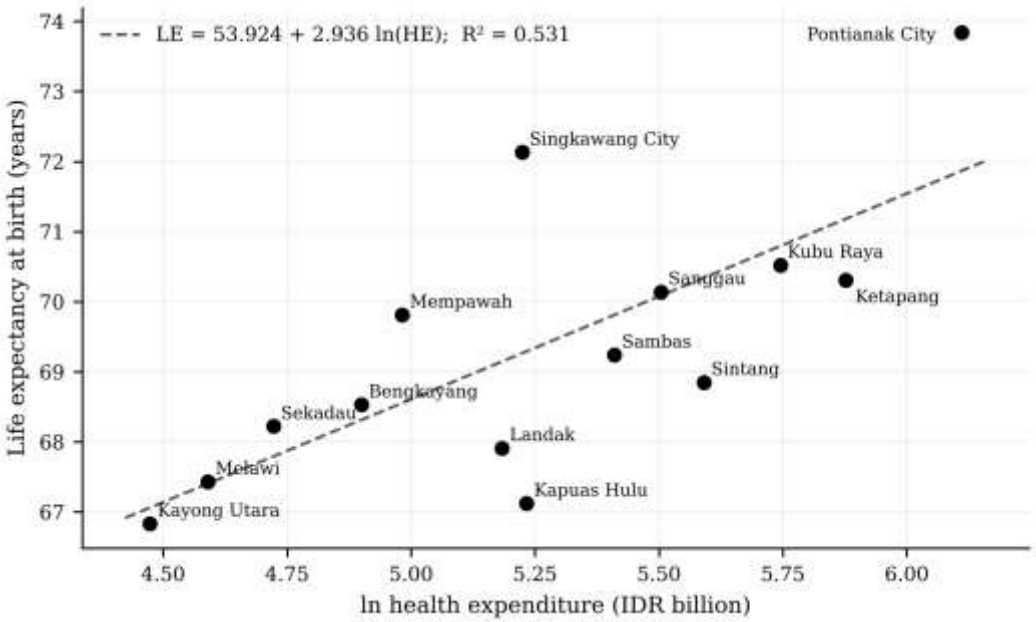


Fig. 1. Relationship between log health expenditure and life expectancy in the 14 regencies/municipalities of West Kalimantan, 2023.

Singkawang City (+2.87 years) and Pontianak City (+1.98 years) record life expectancy well above the model prediction, whereas Kapuas Hulu (−2.17 years), Sintang (−1.49 years), Landak (−1.24 years), and Ketapang (−0.87 years) fall below it. Regions with negative residuals are generally large inland regencies with relatively high poverty, while those with positive residuals are urban areas. This pattern suggests that the same rupiah yields different health outcomes depending on regional characteristics.

d. Robustness checks

Robustness was examined in two ways. First, the poverty rate was added as a control variable (Model 2). The coefficient of $ln(HE_i)$ falls from 2.936 to 0.831 (a decline of about 72 percent) and is no longer significant (p = 0.143; HC3 p = 0.135). In contrast, poverty has a negative and highly significant effect (β = −0.574; p < 0.001): each 1 percentage point increase in poverty is associated with life expectancy lower by about 0.57 years. Adding poverty raises the R^2 from 0.531 to 0.893.

Second, because Pontianak City has the highest Cook's distance (0.640; still below the threshold of 1), the main model was re-estimated without it. The coefficient of $ln(HE_i)$ remains positive and significant (β = 2.147; p = 0.027; n = 13), although smaller. In addition, the Spearman rank correlation between health expenditure and life expectancy is 0.732 (p = 0.003). The bivariate association is therefore not driven by a single extreme observation, but it largely overlaps with cross-regional variation in poverty.

2. Discussion

The positive effect of health expenditure on life expectancy is consistent with Grossman's health capital theory (Grossman, 1972) and with empirical evidence from developing and developed regions (Anwar et al., 2023; Anyanwu & Erhijakpor, 2009; Bokhari et al., 2007; Rahman et al., 2018). Regions with larger health budgets have the fiscal space to operate more facilities, finance health workers, and run immunisation, nutrition, and communicable disease control programmes that reduce infant and child mortality, the

component that most strongly determines life expectancy at birth.

The robustness results, however, add an important nuance. The weakening of the spending coefficient once poverty is controlled for is in line with evidence that socio-economic factors explain most of the variation in health outcomes, while the effect of public spending is small once these factors are taken into account (Filmer & Pritchett, 1999). In West Kalimantan, regions with large health budgets tend to be urban or populous areas with low poverty, such as Pontianak City and Kubu Raya Regency. Part of the association between spending and life expectancy thus reflects differences in household welfare rather than the budget effect alone.

This finding is also consistent with the capability approach (Anand & Ravallion, 1993; BPS, 2026). Poverty limits households' ability to use publicly financed services, for instance through transport costs to puskesmas in remote areas, undernutrition, poor sanitation, and low health literacy. Ketapang and Sintang illustrate this: both rank among the top five in health spending, yet their life expectancy lies below the model prediction. Conversely, Singkawang City, with mid-range spending, achieves high life expectancy, supported by low poverty and short distances to services.

The results further support the view that the effectiveness of health spending depends on governance and allocation quality (Farag et al., 2013; Rajkumar & Swaroop, 2008). Nominal spending does not distinguish between personnel costs, capital spending on buildings, and promotive-preventive programmes that directly reach the poor, whereas spending is more effective when directed to primary care used by poor groups (Gupta et al., 2002). The main issue in West Kalimantan is therefore not only how large the health budget is, but where and for whom it is spent. Three policy implications follow: health budget increases should be accompanied by performance-based budgeting linked to outcome indicators such as immunisation coverage, skilled birth attendance, and stunting prevalence; allocations should be prioritised for high-poverty, low-life-expectancy regencies such as Kayong Utara, Melawi, and Kapuas Hulu, including through needs-based provincial transfers; and health policy should be integrated with poverty alleviation programmes.

This study has several limitations. The data are cross-sectional for a single year with 14 observations, so statistical power is limited and the results should be interpreted as associations rather than firm causal effects. Health expenditure is measured in aggregate nominal terms rather than per capita, so part of its variation reflects population size. Reverse causality and lagged effects of spending on life expectancy cannot be captured. Future research should use regency-level panel data (e.g., 2018–2023) with fixed- or random-effects models, per capita spending, lagged variables, and additional controls such as health facility access, health workforce, and education.

Conclusion

Local government health expenditure has a positive and significant effect on life expectancy across the 14 regencies and municipalities of West Kalimantan Province: a 10 percent increase in spending is associated with about 0.28 additional years of life expectancy, and spending explains 53.1 percent of cross-regional variation. This effect, however, weakens and becomes insignificant once poverty is controlled for, and poverty emerges as the strongest determinant of life expectancy. The nominal size of health spending is therefore not an independent determinant of population health; its effectiveness depends on the socio-economic conditions of the population and on how precisely allocations are targeted. Local governments in West Kalimantan should shift their policy orientation from the size of the health budget to the quality of spending through performance-based budgeting, prioritise promotive-preventive programmes and primary

care in high-poverty areas, and integrate health policy with poverty alleviation, while the provincial government can use these findings to design needs-based health transfers.

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