

THE EFFECT OF EDUCATION, MINIMUM WAGE, AND LIFE EXPECTANCY ON THE FEMALE LABOR FORCE PARTICIPATION RATE ACROSS REGENCIES/MUNICIPALITIES IN BALI PROVINCE, 2018-2025

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Abstract:

This study examines the associations of female education, regency/municipal minimum wages, and female life expectancy with female labor force participation across Bali's nine regencies and municipality during 2018-2025. Secondary panel data from Statistics Indonesia were analyzed using a fixed-effects model selected through Chow and Hausman tests. The model incorporated region-specific fixed effects to control for time-invariant differences among localities. The findings indicate that the explanatory variables jointly account for meaningful variation in female labor force participation. Education is negatively and significantly associated with participation, whereas the minimum wage is positively and significantly associated with participation. Life expectancy has a negative but statistically insignificant association. The negative education coefficient may reflect school-to-work transitions, skill mismatches, job selectivity, or care responsibilities, although these mechanisms were not directly tested. The positive wage association may capture stronger labor-supply incentives and broader regional economic conditions rather than a direct causal effect of wage regulation. Aggregate life expectancy appears insufficiently sensitive to the health conditions of working-age women. These findings underscore the importance of aligning education with local employment opportunities, strengthening support for women's transition into work, and using more specific health indicators. Because the analysis is observational, the results should be interpreted as associations rather than causal relationships.

Keywords: Female Labor Participation, Education, Minimum Wage, Life Expectancy.

INTRODUCTION

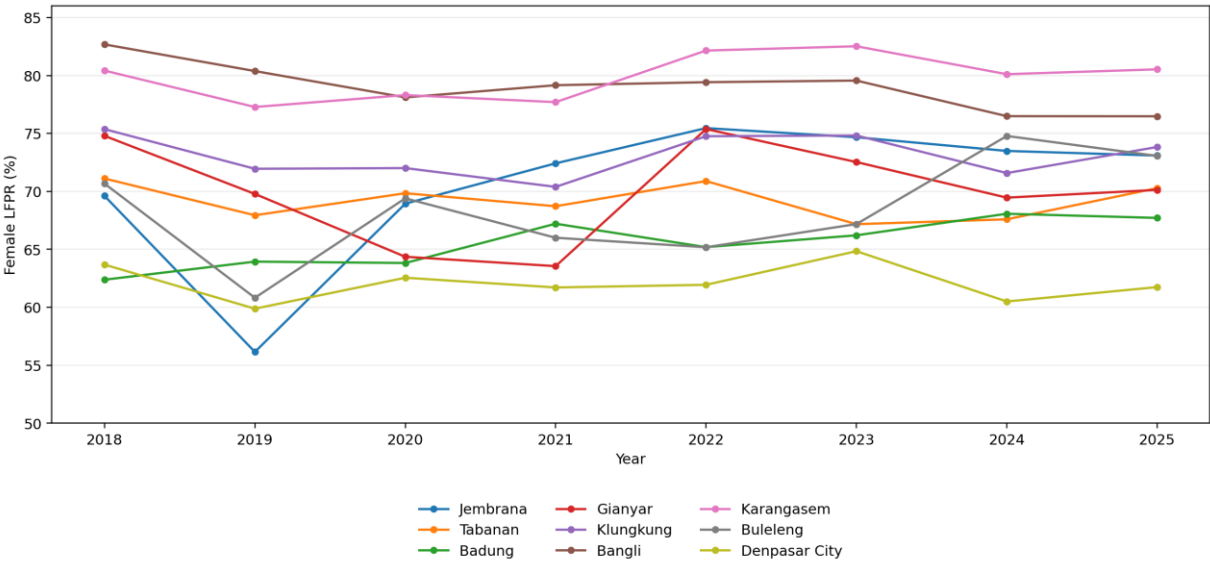
The female labor force participation rate is an important indicator of women's involvement in productive economic activity and is closely related to the fifth Sustainable Development Goal on gender equality and women's empowerment. Greater participation can strengthen household income, reduce poverty risks, expand the production base, and support regional growth (Mutia S & Kartiasih, 2024). Nevertheless, the national gender gap remains substantial: women's participation was 56.42% in 2024, compared with 84.66% for men, and its increase from 51.80% in 2018 to 56.63% in 2025 did not eliminate unequal access to employment opportunities (Seftriandri, 2025; BPS, 2025b). Bali differs from the national pattern. Across its regencies and municipality during 2018-2025, the average female participation rate was 71.15%, ranging from 56.15% to 82.68%. Bangli and Karangasem generally recorded higher rates, whereas Denpasar City was relatively lower. These spatial differences reflect variations in economic structure, employment opportunities, and social



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characteristics (BPS, 2025b). Bali's patrilineal kinship system and women's combined domestic, economic, customary, and religious responsibilities may also constrain working-time flexibility, including among women employed in tourism (Manuhutu & Pricilia, 2025; Muliantari, 2025).

Figure 1. Female Labor Force Participation Rates across Bali Regencies/Municipality, 2018-2025



Source: Statistics Indonesia, Bali Province; processed data (2018-2025).

The 2018-2025 period captures the pre-pandemic years, the COVID-19 disruption, and the economic recovery, thereby allowing female labor participation to be examined while Bali's tourism and service sectors experienced uneven pressure and recovery. Agricultural and informal-sector regencies may display participation patterns that differ from tourism-dependent formal economies, making regency/municipal analysis necessary. Human Capital Theory explains education and health as investments that can improve knowledge, skills, work capacity, and productivity (Becker, 1993). Education may increase marginal productivity, expected earnings, and access to formal employment, although its relationship with participation may depend on skill matching, industry structure, care responsibilities, and the school-to-work transition (Anifatul et al., 2022; Haris & Nurhidayah, 2025). Life expectancy is used as an aggregate health proxy, but it does not directly measure the health, reproductive conditions, or functional limitations of working-age women. Minimum wages are therefore not treated as human capital; they are examined through labor-supply, labor-demand, and neoclassical perspectives. Higher wages may encourage labor supply, while rising labor costs may reduce demand for workers, particularly in labor-intensive and low-skilled sectors (Julianto et al., 2024; Pradnyaswari et al., 2018; BPS, 2025c).

Empirical findings for the three variables remain inconsistent. Education is commonly associated with higher female labor participation, but the magnitude varies across socioeconomic settings (Anifatul et al., 2022; Haris & Nurhidayah, 2025). Minimum wages may stimulate labor supply through stronger income incentives, yet they may also reduce employment absorption when labor costs rise (Sari & Sugiharti, 2022). Life expectancy has produced mixed and frequently insignificant results as an aggregate health indicator (Dwiyanti, 2022; Situmorang, 2023; Sutranggono et al., 2024). In addition, many previous studies relied on provincial data or time-series analysis and therefore could not capture persistent differences among regencies and municipalities. Such approaches may overlook heterogeneity in industrial structure, tourism dependence,



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education access, wage policy, and health conditions. A panel model for Bali's nine localities can analyze cross-regional and temporal variation simultaneously, while fixed effects can control for unobserved regional characteristics that remain relatively constant over time.

Accordingly, this study analyzes the associations of education, regency/municipal minimum wages, and female life expectancy with female labor force participation across Bali's nine regencies and municipality during 2018-2025. Its contribution lies in using a subprovincial panel spanning the pre-pandemic, pandemic, and recovery periods while controlling for time-invariant regional heterogeneity. Given the uncertainty in prior findings, the hypotheses are non-directional: H1 states that education is significantly associated with female labor force participation; H2 states that the regency/municipal minimum wage is significantly associated with female labor force participation; and H3 states that life expectancy is significantly associated with female labor force participation.

METHODS

This study employed an explanatory quantitative design and panel-data regression to examine the statistical relationships of education, the regency/municipal minimum wage, and life expectancy with female labor force participation. The units of analysis were Bali's eight regencies and Denpasar City over eight years from 2018 to 2025, producing an initial balanced panel of 72 region-year observations. Secondary data were obtained from official Statistics Indonesia publications. The dependent variable was the female labor force participation rate (Y), while the independent variables were female average years of schooling (X1), the regency/municipal minimum wage (X2), and female life expectancy (X3); their operational definitions, units, transformations, and sources are presented in Table 1. Descriptive statistics are reported in original units. In the estimation output, the participation rate and life expectancy were multiplied by 100, so the coefficients were returned to their original units before substantive interpretation. Model selection proceeded through the Chow test, comparing the Common Effect Model with the Fixed Effect Model, and the Hausman test, comparing the Fixed Effect Model with the Random Effect Model. Predictor correlations below the preliminary threshold of 0.80 were used as an initial multicollinearity check. Heteroskedasticity was assessed with the Glejser test by regressing the absolute residuals on X1, X2, and X3; probabilities above 0.05 were interpreted as no evidence of heteroskedasticity at the 5% level. The Durbin-Watson statistic was reported as an initial indication of autocorrelation, although panel-specific autocorrelation and cross-sectional dependence tests were unavailable. The hypotheses were assessed using t-tests, the F-test, and the coefficient of determination at a 5% significance level. In the model, i denotes the regency/municipality, t denotes 2018-2025, α is the constant, β_1 - β_3 are regression coefficients, μ_i is the region-specific fixed effect, and ε_{it} is the error term. AYS , UMK , and LE denote female average years of schooling, the regency/municipal minimum wage, and female life expectancy, respectively. Because the data are observational, the coefficients are interpreted as statistical associations rather than direct causal effects. The estimated relationship is specified below.

$$FLFPR_{it} = \alpha + \beta_1AYS_{it} + \beta_2UMK_{it} + \beta_3LE_{it} + \mu_i + \varepsilon_{it}$$



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Table 1. Operational Definitions of Variables

Variable	Operational definition	Unit/transformation	Source
Female LFPR (Y)	Percentage of working-age women who are in the labor force. Formula: female labor force divided by the working-age female population x 100%.	Percent; estimation output uses $Y^* = 100 \times \text{LFPR}$.	Statistics Indonesia, Bali Province: labor force participation by regency/municipality and sex.
Education (X1)	Average number of years of formal education completed by women.	Years.	Statistics Indonesia, Bali Province: average years of schooling by regency/municipality and sex.
Minimum wage (X2)	Monthly minimum wage applicable in each regency/municipality.	Rupiah per month.	Statistics Indonesia, Bali Province: regency/municipal minimum wage.
Life expectancy (X3)	Expected average number of years that women will live under prevailing mortality patterns.	Years; estimation output uses $X3^* = 100 \times \text{LE}$.	Statistics Indonesia, Bali Province: life expectancy by regency/municipality and sex.

Note: The titles and numbers of the Statistics Indonesia tables should be aligned with the original links used by the authors.

RESULT AND DISCUSSION

Descriptive Statistics

Descriptive statistics summarize the main characteristics of each variable used in the analysis.

Table 2. Descriptive Statistics

	Y (Female LFPR)	X1 (Education)	X2 (UMK)	X3 (Life Expectancy)
Mean	71.1497	8.0458	2,679,390	75.2615
Median	70.7810	7.9050	2,678,153	75.3750
Maximum	82.6800	11.4800	3,534,339	79.1600
Minimum	56.1500	5.1800	2,128,253	71.9500
Std. Dev.	6.3986	1.6757	302,441	1.9452

Table 2 shows that female labor force participation averaged 71.15%, with a median of 70.78%, a maximum of 82.68%, and a minimum of 56.15%. The standard deviation of 6.40 percentage points indicates variation across localities and years. The proximity of the mean and median suggests similar distributional centers, although outlier identification would require additional examination.

Female average years of schooling was 8.05 years, with a median of 7.91 years, a maximum of 11.48 years, a minimum of 5.18 years, and a standard deviation of 1.68 years. These values indicate meaningful differences in female educational attainment among Bali localities.

The minimum wage averaged Rp2,679,390 per month and had a median of Rp2,678,153. Its maximum was Rp3,534,339, its minimum was Rp2,128,253, and its standard deviation was Rp302,441, reflecting differences in regional economic structure and capacity.



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Female life expectancy averaged 75.26 years and had a median of 75.38 years. The maximum was 79.16 years, the minimum was 71.95 years, and the standard deviation was 1.95 years. Relative to the other variables, life expectancy displayed less cross-regional dispersion.

Model Specification Tests

Table 3. Chow Test

Effects Test	Statistic	d.f.	Probability
Cross-section F	5.82313	(8,50)	0.0000
Cross-section Chi-square	40.820854	8	0.0000

The Chow test produced probabilities of 0.0000 for both the cross-section F and cross-section chi-square statistics, below 0.05. The Fixed Effect Model was therefore preferred to the Common Effect Model.

Table 4. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Probability
Cross-section random	11.227347	3	0.0106

The Hausman test yielded a probability of 0.0106, below 0.05. Accordingly, the Fixed Effect Model was selected over the Random Effect Model and used for the subsequent analysis.

Diagnostic Tests

Table 5. Predictor Correlation Matrix

Variable	X1 (Education)	X2 (UMK)	X3 (Life Expectancy)
X1 (Education)	1.000000	0.285638	0.134571
X2 (UMK)	0.285638	1.000000	-0.0458
X3 (Life Expectancy)	0.134571	-0.0458	1.000000

The correlation matrix reports X1-X2 at 0.2856, X1-X3 at 0.1346, and X2-X3 at -0.0458. All absolute values are below the preliminary threshold of 0.80, indicating no very strong linear correlation among predictors. Because variance inflation factors and tolerance values were unavailable, this conclusion is limited to an initial screening rather than a complete multicollinearity diagnosis.

Table 6. Glejser Heteroskedasticity Test

Variable	Coefficient	Std. Error	t-statistic	Probability
C	-595.5409	2479.053	-0.240229	0.8111
X1 (Education)	132.8459	178.4753	0.744338	0.4602
X2 (UMK)	-0.000328	0.000296	-1.108197	0.2731
X3 (Life Expectancy)	0.080802	0.358056	0.225668	0.8224

The Glejser test regressed the absolute residuals on education, the minimum wage, and life expectancy. The probabilities were 0.4602 for X1, 0.2731 for X2, and 0.8224 for X3; all exceeded 0.05. Thus, the Glejser test provided no evidence of heteroskedasticity at the 5% level.



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Fixed-Effects Estimation

Table 7. Fixed Effect Model Estimation

Variable	Coefficient	Std. Error	t-statistic	Probability
C	14324.95	4182.233	3.425193	0.0012
X1 (Education)	-263.914	71.03189	-3.715429	0.0005
X2 (UMK)	0.000966	0.000324	2.977706	0.0044
X3 (Life Expectancy)	-1.019602	0.674683	-1.511231	0.1368
R-squared	0.714597	Durbin-Watson statistic		1.930306
Adjusted R-squared	0.651174	Mean dependent variable		7213.893
S.E. of regression	349.2738	S.D. dependent variable		591.3731
Sum squared residuals	5,489,650	Akaike information criterion		14.72376
Log likelihood	-401.2652	Schwarz criterion		15.12159
F-statistic	11.26717	Hannan-Quinn criterion		14.878
Prob(F-statistic)	0.000000			

Table 7 is the final Fixed Effect Model output used consistently in the equation, partial tests, discussion, abstract, and conclusion. In the software output, female labor force participation and life expectancy were multiplied by 100. The equation on the output scale is:

$$FLFPR^*_{it} = 14,324.95 - 263.914 \text{ }AYS_{it} + 0.000966 \text{ }UMK_{it} - 1.019602 \text{ }LE^*_{it} + \mu_i + \varepsilon_{it}$$

After female labor force participation and life expectancy are returned to their original units, the substantive equation becomes $FLFPR_{it} = 143.2495 - 2.63914 \text{ }AYS_{it} + 0.00000966 \text{ }UMK_{it} - 1.019602 \text{ }LE_{it} + \mu_i + \varepsilon_{it}$. The constant of 143.2495 is the predicted participation rate when all independent variables equal zero; because this condition falls outside the observed ranges, the constant has no direct substantive interpretation. One additional year of average schooling is associated with a 2.639-percentage-point decline in female participation. A Rp100,000 increase in the minimum wage is associated with a 0.966-percentage-point increase in female participation. A one-year increase in life expectancy is associated with a 1.020-percentage-point decline. These interpretations are ceteris paribus and remain subject to each coefficient's statistical significance.

Partial Significance Tests

Education (X1) has a negative coefficient, a t-statistic of -3.715429, and a probability of 0.0005. Because the probability is below 0.05, education is negatively and significantly associated with female labor force participation during the study period; H1 is supported.

The minimum wage (X2) has a positive coefficient, a t-statistic of 2.977706, and a probability of 0.0044. Because the probability is below 0.05, the minimum wage is positively and significantly associated with female labor force participation; H2 is supported.

Life expectancy (X3) has a negative coefficient, a t-statistic of -1.511231, and a probability of 0.1368. Because the probability exceeds 0.05, life expectancy is not significantly associated with female labor force participation; H3 is not supported.



Simultaneous Significance Test

The F-test produced a Prob(F-statistic) of 0.000000, below 0.05. Education, the minimum wage, life expectancy, and regional fixed effects are therefore jointly significant in explaining variation in female labor force participation within the estimated model.

Coefficient of Determination

The R-squared value of 0.714597 indicates that the three independent variables together with regency/municipal fixed effects explain 71.46% of the observed variation in female participation. After accounting for the number of parameters in the Fixed Effect Model, the adjusted R-squared of 0.651174 indicates an in-sample explanatory share of 65.12%, while the remaining 34.88% is associated with omitted factors and the error component. This statistic describes in-sample explanatory power and should not be interpreted as predictive performance because no out-of-sample validation was conducted.

Education and Female Labor Force Participation

The Fixed Effect Model indicates a negative and significant association between education and female labor force participation. After scale adjustment, one additional year of female average schooling is associated with a 2.639-percentage-point decline in participation. This direction differs from Human Capital Theory and most previous findings, which predict that education improves productivity and employment opportunities (Becker, 1993; Anifatul et al., 2022; Haris & Nurhidayah, 2025). The result may be related to longer school-to-work transitions, mismatches between qualifications and local job opportunities, greater job selectivity, or care responsibilities. These mechanisms were not directly tested and should therefore be treated only as possible explanations. The finding suggests that higher educational attainment may not automatically translate into greater participation when job creation, support services, and labor-market matching remain inadequate.

Minimum Wage and Female Labor Force Participation

The regency/municipal minimum wage is positively and significantly associated with female labor force participation. After returning the coefficient to its original unit, a Rp100,000 increase in the minimum wage is associated with an approximately 0.966-percentage-point increase in participation. This result is consistent with the labor-supply mechanism in which higher wages increase the economic benefit of working and encourage more women to enter the labor force. The positive direction differs from the neoclassical labor-demand prediction that higher wage costs may reduce employment absorption (Julianto et al., 2024; Sari & Sugiharti, 2022). At the regional level, higher minimum wages may also reflect greater productivity, stronger economic activity, and more formal employment opportunities. Because wage levels may be determined simultaneously with regional economic conditions, the result does not establish that a wage increase directly causes higher female participation.

Life Expectancy and Female Labor Force Participation

Life expectancy has a negative but statistically insignificant association with female labor force participation. After scale adjustment, a one-year increase in life expectancy is associated with a 1.020-percentage-point decline, but the relationship is not statistically distinguishable from zero at the 5% level. Aggregate life expectancy may be insufficiently sensitive to the health conditions that shape work decisions among women of productive age. The finding is consistent with research reporting an insignificant effect on female participation (Situmorang, 2023). This study did not test age structure, reproductive health, disability, or the health status of working-age women; consequently,



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the negative direction cannot be attributed to a larger elderly population. Future studies should use health indicators that more specifically represent working-age women.

CONCLUSION

The final Fixed Effect Model shows that education is negatively and significantly associated with female labor force participation, while the regency/ municipal minimum wage is positively and significantly associated with participation. Life expectancy has a negative but insignificant association. Jointly, the explanatory variables and regional fixed effects are significant in accounting for variation in female participation. The education result highlights the importance of school-to-work transitions, skill alignment with local economic needs, suitable employment opportunities, and care support. The positive wage association should be interpreted as a regional relationship that may also reflect productivity and economic structure, rather than as direct evidence for raising or lowering minimum wages. The insignificant life-expectancy result indicates the need for health measures that more specifically represent working-age women.

Because the study uses observational data, its findings do not establish causal relationships. Potential endogeneity, the effective number of observations in the estimation output, and the absence of panel-specific autocorrelation and cross-sectional dependence tests remain limitations requiring verification. Further research should employ impact-evaluation or quasi-experimental designs, test endogeneity, apply Pesaran cross-sectional dependence and panel autocorrelation tests, and use robust or clustered standard errors when necessary. Regional governments may use the findings to monitor how education, wages, health, and female labor participation move together, but changes in minimum-wage policy require additional causal evidence.

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