Analysis of the Influence of Life Expectancy and Per Capita Food Expenditure on the Human Development Index in Central Java, 2023

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ABSTRAK

Penelitian ini menganalisis pengaruh usia harapan hidup dan pengeluaran per kapita makanan di wilayah perkotaan terhadap *Human Development Index* (HDI) di 35 kabupaten/kota Provinsi Jawa Tengah. Metode regresi linier berganda digunakan untuk mengestimasi pengaruh simultan dan parsial, dengan HDI sebagai variabel dependen, serta usia harapan hidup dan pengeluaran per kapita makanan sebagai variabel independen. Hasil estimasi menunjukkan bahwa usia harapan hidup dan pengeluaran per kapita makanan berpengaruh signifikan terhadap HDI. Secara parsial, usia harapan hidup berpengaruh positif dan signifikan terhadap HDI ($\beta = 1{,}913$), sedangkan pengeluaran per kapita makanan berpengaruh negatif dan signifikan ($\beta = -0{,}384$). Koefisien negatif ini mengindikasikan bahwa peningkatan pengeluaran pangan belum tentu mencerminkan peningkatan HDI, yang dapat mencerminkan inefisiensi konsumsi atau rendahnya kualitas gizi pangan. Nilai Adjusted R^2 sebesar 0,726 menunjukkan bahwa model regresi mampu menjelaskan 72,6% variasi HDI, sedangkan sisanya dijelaskan oleh variabel lain di luar model. Temuan ini menegaskan kebijakan pembangunan manusia di Jawa Tengah perlu difokuskan tidak hanya pada peningkatan daya beli, tetapi juga pada perbaikan kualitas kesehatan dan efisiensi pola konsumsi pangan masyarakat. Implikasi hasil penelitian ini dapat menjadi dasar dalam perumusan kebijakan pembangunan manusia yang lebih terarah dan berkelanjutan di Jawa Tengah.

Kata kunci: Regresi Linier Berganda, *Human Development Index* (HDI), Usia Harapan Hidup, Pengeluaran Per Kapita Makanan

ABSTRACT

This study analyzes the effect of life expectancy and per capita food expenditure in urban areas on the Human Development Index (HDI) in 35 regencies/cities of Central Java Province. A multiple linear regression method was employed to estimate both simultaneous and partial effects, with HDI as the dependent variable and life expectancy and per capita food expenditure as independent variables. The estimation results indicate that both life expectancy and per capita food expenditure significantly affect HDI. Partially, life expectancy has a positive and significant effect on HDI ($\beta = 1.913$), while per capita food expenditure has a negative and significant effect ($\beta = -0.384$). The negative coefficient suggests that increased food expenditure does not necessarily correspond to higher HDI, which may reflect consumption inefficiency or low nutritional quality of food. The Adjusted R^2 value of 0.726 indicates that the regression model explains 72.6% of the variation in HDI, with the remainder explained by other factors outside the model. These findings highlight that human development policies in Central Java should focus not only on increasing purchasing power but also on improving health quality and the efficiency of food consumption patterns. The results can serve as a basis for formulating more targeted and sustainable human development policies in Central Java.

Keywords: *Multiple Linear Regression, Human Development Index (HDI), Life Expectancy, Per Capita Food Expenditure*

INTRODUCTION

The Human Development Index (HDI) is a fundamental indicator for assessing human development, covering the dimensions of health, education, and a decent standard of living [1], [2]. It serves as a benchmark for evaluating government performance and a key reference in formulating development policies in Indonesia [3]. Despite its importance, HDI achievements reveal substantial regional disparities. Central Java Province, one of Indonesia's most populous provinces, has consistently recorded HDI values below the national average in recent years [4]. This indicates persistent structural challenges in improving the quality of life, particularly concerning interregional inequality and limited access to basic services such as healthcare and adequate food consumption [5]. Although economic growth has been relatively stable, welfare improvements in Central Java have not been evenly distributed, especially between urban and rural areas [6], [7].

Previous studies have emphasized the role of health and economic factors as key determinants of human development outcomes. The health dimension is often measured by life expectancy at birth, which serves as a proxy for overall population health [8]. Higher life expectancy reflects better public health conditions and greater access to quality healthcare services. The standard of living dimension is typically assessed through indicators of purchasing power or per capita expenditure [9]. Per capita food expenditure, in particular, is a critical measure of household economic capacity to meet nutritional needs. Access to sufficient and nutritious food supports individual health and productivity, which in turn affects overall quality of life and HDI [10].

Several studies have explored the determinants of HDI, which can be grouped into three main themes. Research on HDI determinants highlights the influence of health and economic factors, with life expectancy as a key indicator. Pradana and Juliannisa examined HDI determinants in DKI Jakarta, although their study was limited to a metropolitan context and does not reflect socioeconomic variations across provinces [11]. Studies on per capita expenditure indicate that household purchasing power significantly affects HDI. Fauziiyyah and Tarihoran analyzed this effect but used aggregate expenditure, not distinguishing between food and non-food items [12]. Some studies link life expectancy and per capita expenditure to poverty, but they do not directly examine the relationship with HDI. Rambe et al. investigated the influence of life expectancy and per capita expenditure on poverty levels, again without directly connecting these variables to HDI [13].

Despite the growing literature, research gaps remain. Most prior studies examine health and economic factors separately [14], use aggregate expenditure indicators, or focus on single cities rather than provincial contexts [15]. Studies that simultaneously analyze the effect of life expectancy and urban per capita food expenditure on HDI at the provincial level remain limited [16]. Urban per capita food expenditure is particularly relevant because price levels, consumption patterns, and data reliability differ between urban and rural areas, providing a more precise reflection of household economic capacity.

This study aims to analyze the effects of life expectancy and urban per capita food expenditure on HDI in Central Java Province using multiple linear regression [17]. By quantifying both the simultaneous and individual contributions of these factors, the study provides insights for policymakers to improve public health, ensure equitable access to nutritious food, and elevate HDI across the province. Based on these objectives, the following hypotheses are formulated: H_1: Life expectancy and urban per capita food expenditure simultaneously have a significant effect on the Human Development Index in Central Java Province, H_2: Life expectancy has a significant partial effect on the Human Development Index in Central Java Province, and H_3: Urban per capita food expenditure has a significant partial effect on the Human Development Index in Central Java Province.

METHOD

The data used in this study are secondary data obtained from Statistics Indonesia (BPS) of Central Java Province for the year 2023. The year 2023 was selected because it represents the most recent data available and reflects socioeconomic conditions during the post-pandemic recovery period, which is particularly relevant for assessing human development dynamics. The collected variables include: the Human Development Index (Y, index 0–1) for each regency/municipality as the dependent variable, Life Expectancy at Birth (X_1, years), and Per Capita Food Expenditure in Urban Areas (X_2, rupiah) for each regency/municipality as the independent variables. The data were collected from 35 regencies/municipalities and processed using IBM SPSS software. This study adopts a cross-sectional design because the analysis focuses on variation across districts/cities within Central Java at a single point in time. Cross-sectional data are appropriate for capturing structural differences in socioeconomic and demographic characteristics across regions, enabling the model to assess how such variations explain differences in the Human Development Index.

Multiple linear regression was employed to assess how the two independent variables influence the dependent variable. To ensure the validity of the regression model, classical assumption tests were conducted, including a normality test, a multicollinearity test, and a heteroscedasticity test. After formulating the hypotheses, the classical assumptions were tested, followed by significance testing using the F-test and t-test. Additionally, a model fit assessment was conducted using the coefficient of determination (R^2) to obtain the best-fit model for the multiple linear regression analysis.

1. Multiple Linear Regression Analysis

Multiple linear regression refers to a statistical approach for analyzing the relationship between one outcome variable, denoted as Y, and two or more predictor variables as X_1, X_2, X_3, etc and [18].

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon, \tag{1}$$

description:

β_0 : intercept (constant),

β_i : slope,

X : independent variable,

Y : dependent variable,

ε : error term (disturbance variable),

where in this study, Y denotes the Human Development Index, X_1 represents life expectancy at birth in years, and X_2 denotes urban per capita food expenditure in rupiah. The constant term (β_0) has no substantive meaning as predictors cannot be zero.

2. Classic Assumption Test

Classical assumption tests were conducted, including a normality test, a multicollinearity test, and a heteroscedasticity test:

a. Data Cleaning Step

Before the analysis, several data cleaning procedures were conducted to ensure the accuracy and reliability of the dataset. The process included checking for missing values, inconsistencies, and outliers in each variable. The data were also examined for potential entry errors, such as unrealistic values. No extreme outliers required adjustment, and all remaining variables were verified for unit consistency (years, rupiah, index) and suitability for regression analysis to ensure compatibility with the regression model; these steps represent the data cleansing conducted in this study. Additionally, all variables were screened for appropriate measurement units and consistency to ensure compatibility for regression analysis.

b. Normality Test

The normality test evaluates if the model's residuals are normally distributed. A model is considered acceptable if the residuals distribution is normal, indicated by a p-value > 0.05 [18]. The normality was tested using the Kolmogorov-Smirnov method.

c. Heterocedasticity Test

The heteroscedasticity test is conducted to examine whether the residuals exhibit constant variance. A regression model is considered reliable if there is no indication of heteroscedasticity, which is typically shown by a p-value > 0.05 [19]. This study employed the Glejser test to assess heteroscedasticity.

d. Multicollinearity Test

Multicollinearity refers to the presence of a linear relationship among independent variables in a regression model. This relationship may be either perfect or imperfect. To detect multicollinearity, researchers examine the correlation coefficients between predictors and calculate the Variance Inflation Factor (VIF). Multicollinearity is potentially indicated when the VIF value exceeds 10, whereas a VIF < 10 suggests that multicollinearity is not a concern [19].

3. Hypothesis Test

Hypothesis testing was carried out using the F-test, t-test, and the coefficient of determination (R^2).

a. F-Test

Simultaneous testing to evaluate whether all independent variables collectively exert a statistically significant influence on the dependent variable. Decision rule: reject H_0 if p-value < 0.05 [19]. The hypothesis testing is as follows:

H_0: $\beta_1 = 0$ (the relationship is not statistically significant),

H_1: $\beta_1 \neq 0$ (the relationship is statistically significant),

b. Coefficience of Determinant Test

The adjusted coefficient of determination (Adjusted R^2) reflects the proportion of variance in the dependent variable explained by the independent variables. Values closer to 1 indicate stronger explanatory power.

c. T-Test

Partial testing to determine whether each independent variable has a statistically significant effect on the dependent variable individually. Decision rule: reject H_0 if p-value < 0.05 [19]. The hypothesis testing is as follows:

H_0: $\beta_1 = 0$ (the partial correlation between X and Y is not statistically significant),

H_1: $\beta_1 \neq 0$ (the partial correlation between X and Y is statistically significant),

RESULT AND DISCUSSION

The following section outlines the results of the study, starting with descriptive statistics, the classic assumption test, model fit test, partial test, and the analysis of the multiple linear regression model.

1. Descriptive Statistics

Descriptive statistics are presented in Table 1 for the three variables used: Human Development Index (Y), Life Expectancy (X_1) in years, and Per Capita Food Expenditure (X_2) in rupiah, based on data from 35 regencies/municipalities in Central Java. The descriptive statistics include the number of observations (N), mean, maximum value, standard deviation, variance and minimum value for each variable.

Table 1. The Descriptive Statistics of Data

Variable	N	Mean	Standard Deviation	Varians	Max	Min
Y	35	74.31	4.28	18.32	84.99	68.08
X_1	35	75.55	1.32	1.74	77.93	73.95
X_2	35	47.76	3.83	14.67	54.21	39.34

The descriptive statistics in Table 1 reveal several important patterns. HDI varies considerably across districts, ranging from 68.08 to 84.99, indicating heterogeneous levels of human development. Life expectancy is relatively homogeneous, with a narrow range of 73.95–77.93 years, suggesting uniform access to basic health services. Urban per capita food expenditure exhibits moderate variability, highlighting differences in household economic capacity across regions. These observations suggest that while health outcomes are relatively stable, economic disparities may play a more complex role in shaping HDI.

2. The Classic Assumption Test

The classical assumption tests aim to ensure that the resulting regression model provides reliable, unbiased, and consistent estimates. For clarity and conciseness, the results of normality, heteroskedasticity, and multicollinearity tests are summarized below in Tables 2 and 3. In this research, the autocorrelation test was not applied, as the data used are cross-sectional data.

The normality test is used to examine whether the residuals are normally distributed. The test was conducted using the Kolmogorov-Smirnov method. Based on Table 2, the test statistic value of Kolmogorov-Smirnov (K-S) is 0.093, and the Asymp. Sig. (2-tailed) value of 0.200. As this value exceeds the significance level of 0.05, the residuals are considered to be normally distributed.

Table 2. The Normality Test

	Unstandardized Residual
N	35
Test Statistic	0.093
Asymp. Sig. (2-tailed)	0.200[c.d]

The heteroscedasticity test is conducted to examine whether the variance of the residuals remains constant across observations. As shown in Table 3, the significance values for all independent variables exceed 0.05, indicating that there is no evidence of heteroscedasticity, and thus all independent variables can be considered free from heteroscedasticity.

Table 3. The Heteroscedasticity and Multicollinearity Test

	Unstandardized B	**t**	**Sig**	**Collinearity Tolerance**	**Statistics VIF**
(Constant)	-7.278	-0.359	0.722		
X_1	0.156	0.675	0.504	0.539	1.855
X_2	0.080	-0.742	0.464	0.539	1.855

The multicollinearity test is conducted to identify potential high correlations among independent variables, which could compromise the stability and interpretability of the regression model. As shown in Table 3, each independent variable has a tolerance value greater than 0.1 and a Variance Inflation Factor (VIF) value less than 10, indicating the absence of multicollinearity. Therefore, the model is suitable for regression analysis.

3. Model Fit Test

To assess whether the independent variables collectively have a significant effect on the dependent variable, an F-test, also known as a simultaneous test, is conducted. This test evaluates the overall validity of the regression model by determining whether the set of independent variables included in the model can explain the variability of the dependent variable. The hypotheses for the F-test are formulated as follows:

a. Hypothesis Testing:
   H_0: $\beta_1 = 0$ (the relationship is not statistically significant)
   H_1: $\beta_1 \neq 0$ (the relationship is statistically significant)
b. Significance Level: $\alpha = 0.05$
c. Rejection rules: Reject Ho if F calculated $\geq F_\alpha = F_{0,05} = 3.29$
d. Conclusion:

The calculated F value is 45.951, where 45.951 ≥ 3.29, thus H_0 is rejected. This means that H_1 is accepted, indicating that the variables life expectancy and per capita food expenditure jointly have a significant relationship with the Human Development Index in Central Java.

Table 4. F Test Result

	Sum of Squares	df	Mean Square	F	Sig.
Regression	462.538	2	231.269	45.951	0.000[b]
Residual	161.055	32	5.033		
Total	623.593	34			

Hypothesis testing can also be conducted by examining the significance value (sig) from the SPSS output. Based on Table 4, the calculated F significance value is 0.000, which is less than 0.05 (α = 5%), thus leading to the rejection of H_0. This indicates that the variables of life expectancy and per capita food expenditure have a significant relationship with the Human Development Index in Central Java.

Table 5. R-squared (R^2) Test Results

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.861[a]	0.742	0.726	2.24343

Based on Table 5, the Adjusted Coefficient of Determination or Adjusted R^2 is 0.726, or 72.6%. This indicates that the variability of the factors Life Expectancy and Per Capita Food Expenditure accounts for 72.6% of the variation in the Human Development Index in Central Java, and also indicates high explanatory power for cross-sectional data. The remaining 27.4% may be influenced by factors not included in the study, such as education, sanitation, and income inequality.

4. Partial Test

The partial significance evaluation of each independent variable in the regression model, a t-test was performed. This test assesses whether the individual predictors Life Expectancy (X_1) and Per Capita Food Expenditure (X_2) have a statistically significant effect on the Human Development Index (Y) as presented in Table 6. The hypotheses for the t-test for variable Life Expectancy (X_1) are formulated as follows:

a. Hypothesis Testing:
   H_0: $\beta_1 = 0$ (the relationship between X_1 and Y is not statistically significant)
   H_1: $\beta_1 \neq 0$ (the relationship between X_1 and Y is statistically significant)
b. Significance Level: $\alpha = 0.05$
c. Rejection rules: Reject Ho if t calculated $\geq t_{\alpha/2,\,(n-p-1)} = t_{0.025,\,(32)} = 2.037$
d. Conclusion:
   The calculated t value is 4.828, where 4.828 ≥ 2.037; thus, H_0 is rejected. This means H_1 is accepted, indicating that the Life Expectancy (X_1) variable has a statistically significant relationship with the Human Development Index (Y) in Central Java. The positive t value

indicates a positive correlation, meaning the relationship is in the same direction. In other words, if Life Expectancy increases, the Human Development Index will also increase, and vice versa.

The Hypotheses for the t-test for variable Per Capita Food Expenditure (X_2) are formulated as follows:

a. Hypothesis Testing:
   H_0: $\beta_2 = 0$ (the relationship between X_2 and Y is not statistically significant)
   H_1: $\beta_2 \neq 0$ (the relationship between X_2 and Y is statistically significant)
b. Significance Level: $\alpha = 0.05$
c. Rejection rules: Reject Ho if t calculated $\leq -t_{\alpha/2,\,(n-p-1)} = -t_{0{,}025,\,(32)} = -2{,}037$
d. Conclusion:
   The calculated t value is -2.804, where $-2.804 \leq -2.037$, thus H_0 is rejected. This means H_1 is accepted, indicating that the Per Capita Food Expenditure (X_2) variable has a statistically significant relationship with the Human Development Index (Y) in Central Java. The calculated t value indicates a negative correlation, suggesting an inverse relationship. This means that if Per Capita Food Expenditure increases, the Human Development Index tends to decrease, and vice versa.

Table 6. The Results of Multiple Linear Regression Analysis

	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	-51.880	34.711		-1.495	0.145
X_1	1.913	0.396	0.591	4.828	0.000
X_2	-0.384	0.137	-0.343	-2.804	0.009

The t-test results show that Life Expectancy (X_1) has a significant positive effect on HDI, while Per Capita Food Expenditure (X_2) has a significant negative effect. These results indicate: Increases in life expectancy are associated with higher HDI, likely due to improved healthcare access, reduced mortality, and better population health. This aligns with previous studies [4], [5], [6]. Counterintuitively, higher per capita food expenditure in urban areas is associated with lower HDI. This may reflect Engel's Law, where higher spending on food correlates with lower overall welfare, or inefficiencies in household food spending that do not translate into better nutrition or quality of life. Regional factors, such as urban consumption patterns and inequality, may also explain this pattern.

5. The Multiple Linear Regression Analysis

Based on Table 6, the analysis results indicate the following regression model equation between the dependent and independent variables:

$$Y = -51.880 + 1.913X_1 - 0.384X_2 + \varepsilon, \quad (2)$$

where:

Y : Human Development Index,
X_1 : Life Expectancy,
X_2 : Per Capita Food Expenditure,
ε : error term (disturbance variable).

Based on the regression equation, the interpretation is as follows:

a. Constant (β_0 = -51.880):
when Life Expectancy (X_1) and Per Capita Food Expenditure (X_2) are both equal to zero, the Human Development Index (Y) in Central Java is predicted to be -51.880%.

b. Regression Coefficient β_1 = 1.913:
if Life Expectancy (X_1) increases by 1%, the Human Development Index (Y) in Central Java is expected to increase by 1.913%. Conversely, if Life Expectancy decreases by 1%, the Human Development Index is expected to decreases by 1.913%. This indicates that the coefficient β_1 has a positive correlation, meaning the relationship between X_1 and Y is directly proportional.

c. Regression Coefficient β_2 = -0.384:
if Per Capita Food Expenditure (X_2) increases by 1%, the Human Development Index in Central Java is expected to decrease by 0.384%. Conversely, if X_2 decreases by 1%, the Human Development Index is expected to increase by 0.384%. This indicates that the coefficient β_2 shows a negative correlation, meaning the relationship between X_2 and Y is inversely proportional.

d. Standardized Coefficients Beta
The standardized coefficients indicate that the first predictor, with a Beta value of 0.591, has the strongest and most substantial positive influence on the Human Development Index, meaning that an increase of one standard deviation in this variable leads to an increase of 0.591 standard deviations in HDI. In contrast, the second predictor has a standardized Beta of –0.343, suggesting a moderate negative effect, where a one–standard deviation increase in this variable is associated with a decrease of 0.343 standard deviations in the HDI. These results imply that the first variable serves as the dominant driver of HDI in the model, while the second variable, although influential, contributes negatively to human development outcomes.

The results of the multiple linear regression analysis indicate that life expectancy and urban per capita food expenditure simultaneously influence the Human Development Index (HDI) in Central Java Province, explaining 72.6% of the variation. Partially, life expectancy exerts a strong positive effect on HDI, likely due to improved health infrastructure, reduced mortality, and better access to essential healthcare services, which directly enhance human development outcomes. This finding aligns with prior studies demonstrating that life expectancy is a critical determinant of HDI, as seen in Pradana and Juliannisa [4], Fauziiyyah and Tarihoran [5], and Rambe et al. [6].

Conversely, urban per capita food expenditure exhibits a negative effect on HDI. This counterintuitive result can be interpreted through Engel's Law, which suggests that households with a higher share of income spent on food often have lower overall welfare. Additionally, rising urban food prices may reduce the efficiency of household spending, and higher expenditure on food does not automatically translate into better nutrition or quality of life. Similar patterns have been reported in other regional studies, where food spending alone did not correspond to improvements in human development indices [5], [6], [7]. These findings carry several policy implications. First, local governments should enhance healthcare accessibility and quality, especially in areas with lower life expectancy, to maximize the positive impact on HDI. Second, public education programs on efficient and nutritious food consumption are essential to ensure household expenditures contribute to well-being. Third, social programs should be tailored to the specific socioeconomic conditions of each regency, recognizing the diverse needs and disparities among urban populations.

It is important to note the limitations of this study. Only two independent variables were considered, and the analysis relies on cross-sectional data, which limits causal inference. Furthermore, the focus on urban food expenditure may not reflect rural household dynamics. The remaining 27.4% of unexplained variance in HDI could be attributed to other determinants such as educational attainment, sanitation, income inequality, labor productivity, and local governance effectiveness. In summary, enhancing HDI in Central Java requires more than increasing household income; it demands strategic investments in health, targeted social policies, and efficient resource allocation, combined with interventions to improve both nutrition and welfare outcomes.

CONCLUSION

Based on the results of the multiple linear regression analysis, life expectancy and urban per capita food expenditure significantly influence the Human Development Index (HDI) in Central Java Province, with life expectancy having a positive effect and urban food expenditure a negative effect. The model explains approximately 72.6% of the variation in HDI, indicating strong explanatory power for these two predictors.

Policy implications are clear: first, regional governments should enhance healthcare accessibility and quality, particularly in areas with lower life expectancy; second, public education programs should promote efficient and nutritious food consumption to ensure household spending contributes effectively to human development; and third, social programs should be tailored to the specific socioeconomic conditions of each regency, recognizing variations in consumption capacity and development challenges.

This study has several limitations. First, the cross-sectional design limits causal inference over time, suggesting future research could use panel data to capture temporal dynamics. Second, only two independent variables were included, which may not fully represent the multidimensional nature of HDI; future studies could incorporate additional determinants such as educational attainment, income inequality, or labor productivity. Third, the urban-focused food expenditure variable may not reflect rural household conditions, indicating a need to examine broader or rural-specific measures of consumption in subsequent research.

In summary, enhancing human development in Central Java requires more than increasing household income; it demands strategic investments in health services, informed and efficient household consumption behavior, and targeted social policies to address regional disparities.

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