Comparing the Effect of Food Security on Life Expectancy in Kalimantan and Sulawesi

Kurniawan[1],[*] ⓘD , Made Kembar Sri Budhi[2], I Nyoman Mahaendra Yasa[2],
Ni Made Tisnawati[2], Henrianto[3], Desi Ade Trya[4]

[1]Department of Development Economics, STIE Bulungan Tarakan, Tarakan, Indonesia

[2]Faculty of Economics and Business, Udayana University, Bali, Indonesia

[3]Doctoral Program in Economics, Faculty of Economics and Management, Bogor Agricultural University, Bogor, Indonesia

[4]Land Studies Program, National Land Institute, Yogyakarta, Indonesia

[*]Corresponding Email: mahakaryakurniawanamir@gmail.com

Abstract

*The second Sustainable Development Goal is to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. Food security is a key indicator for these goals. Maintaining food security is crucial to ensuring that no one goes hungry, allowing people to live healthy and long lives. This study offers new evidence explaining the influence of undernourishment, food insecurity, and stunting, with additional explanatory variables such as GDP per capita growth, education, access to adequate housing, and smoking, on life expectancy in Kalimantan and Sulawesi. This study uses panel data regression analysis techniques. It utilizes provincial-level secondary data from the Indonesian Central Bureau of Statistics for 2017-2023. Convincing evidence indicates that undernourishment has a negative and significant impact on life expectancy in Kalimantan (0.06), whereas it has no significant effect in Sulawesi. Education was the dominant variable with a positive and significant effect on life expectancy in Kalimantan (1.86) and Sulawesi (1.60). The variables of food insecurity, stunting, GDP per capita growth, access to adequate housing, and smoking did not significantly affect life expectancy in Kalimantan or Sulawesi. The path to increasing life expectancy is through education and food security maintenance. **This research contributes** to the literature by providing a comparative analysis of the food security-life expectancy nexus in the distinct Indonesian regions of Kalimantan and Sulawesi, offering original evidence for region-specific policy-making.*

Keywords: Access to Adequate Housing, Education, GDP, Food Insecurity, Life policymakingndernourishment, and Smoke

JEL Classifications: I12, I14, and I26

Introduction

Food security is a crucial aspect in determining the quality of human resources. The Free Lunch Program was chosen by the president-elect for the 2024-2029 period to ensure food security for students to stay strong and healthy. According to data from the Central Statistics Agency (BPS) (2024), the average prevalence of food insufficiency in Kalimantan is 10.8 percent. The average prevalence of food insufficiency in Sulawesi was 9.67 percent. Food security remains a serious problem in developing countries (Subramaniam et al., 2023). Food affordability also affects life expectancy in developing countries (Barkat et al., 2024). Food inflation also significantly affects infant and child mortality in Indonesia (Wahyuni, 2023). Maintaining food security is crucial to address hunger and maintain health. Life expectancy is an important indicator of a population's health.

According to data from the Central Statistics Agency (BPS) (2024), the average life expectancy in Kalimantan is 71.68 years, and in Sulawesi it is 69.85 years. The province with the lowest life expectancy in Kalimantan is South Kalimantan (69.42 years), and in Sulawesi, Southeast Sulawesi (66.01 years). Meanwhile, the province with the highest life expectancy in Kalimantan is East Kalimantan (74.72 years), and in Sulawesi, it is North Sulawesi (72.40 years). This explains the disparity in life expectancy between the provinces of Kalimantan and Sulawesi. Development justice is needed in provinces with low life expectancy in Kalimantan and Sulawesi.

Reducing health disparities between provinces in Kalimantan and Sulawesi is challenging. Good health impacts poverty levels (Putra & Robertus, 2022). Empirical evidence also shows that development in the health sector has a positive impact on the overall development outcomes (Yang et al., 2022). Population health can be an important source of cross-country differences in both per-worker and per capita income (Bloom et al., 2024). Empirical evidence explaining the influence of food security on life expectancy across regions is required to strengthen food security programs. There is potential for cooperation between the provinces in Kalimantan and Sulawesi to maintain food security and increase life expectancy.

Literature Review

Inadequate food consumption contributes to both individual and community malnutrition. Regions with high malnutrition estimates have high mortality rates and low productivity (Djoumessi, 2022). Inadequate food consumption leads to hunger and malnutrition, which are more significant in regions with limited natural resources (Uchendu, 2018). Food insecurity leads to poorer health-related quality of life in older adults (Aljahdali et al., 2024).

Maintaining food security in food-insecure areas is crucial for mitigating adverse health impacts. Food security has the opposite effect (Beyene, 2023). Acute food insecurity leads to malnutrition, child mortality, and an increased burden of infectious diseases owing to climate change. Weakening economic conditions can lead to health problems (Hassan et al., 2023). Individuals experiencing food insecurity are more likely to be young, minority, poor, have less education, be obese, smoke, or have diabetes. Individuals experiencing food insecurity have a significantly higher likelihood of long-term mortality (Wright et al., 2023). Lower levels of food security are associated with a higher risk of premature death and a shorter life expectancy (Ma et al., 2024).

Stunting in children significantly increased the risk of death. Stunting and wasting are the consequences of inadequate nutritional intake (Wright et al., 2023). The impact of stunting on child mortality at the population level exceeds that of other risk factors (Wand et al., 2024). Children with disabilities who are stunted and underweight have lower life expectancy (Bukusuba et al., 2018). Meeting food needs with local diets to meet culturally appropriate daily protein intake increases life expectancy and significantly reduces stunting (Rasheed et al., 2021). Research examining the effects of food security on life expectancy is limited. Previous studies have focused on the impact of food security on malnutrition, mortality, and health problems. However, there is limited evidence on life expectancy.

The effect of GDP per capita growth on life expectancy varies. GDP per capita growth has a positive and significant effect on life expectancy (Paramitha et al., 2018; Wirayuda et al., 2024; Kumar & Radulescu, 2024). Setyadi et al. (2023) indicate that GDP per capita growth has a positive but insignificant effect on life expectancy. Furthermore, research by Paramitha et al. (2018) and Wirayuda et al. (2024) is consistent with this finding, showing that education has a positive and significant effect on life expectancy.

Environmental factors such as access to adequate housing also contribute to reduced mortality (Otavova et al., 2022). Lifestyle variables such as smoking do not significantly affect mortality (Sudharsanan & Ho, 2020). Meanwhile, Rentería's (2015) findings indicate that smoking has a negative effect on life expectancy. There is a gap in the evidence explaining the variables that influence life expectancy across the provinces. This study offers new evidence to explain the impact of malnutrition, food insecurity, stunting, GDP per capita growth, education, access to adequate housing, and smoking on life expectancy in Kalimantan and Sulawesi.

Methods

This study uses a quantitative descriptive approach. This study used secondary data from the Central Statistics Agency (BPS). The selected data time range was 2017-2023. The research location covers all provinces in Kalimantan and Sulawesi. Table 1 shows the details of the variables used in this study. Panel data regression was chosen as the data analysis technique. According to Wooldridge (2019), an appropriate fixed effects model was used for the panel data regression analysis. The basic panel data regression model used in this study was based on the following equation:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \ldots + u_i \ \ldots\ldots\ldots (1)$$

Equation 1 describes Y (dependent variable), β (slope), u (unobserved variable), X (independent variable), i (coverage), and t (period). The panel data regression equation developed in this study is as follows:

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + \beta_5 X5_{it} + \beta_6 X6_{it} + \beta_7 X7_{it} + u_i \ \ldots\ldots (2)$$

Equation 2 explains life expectancy (Y), prevalence of undernourishment (X1), prevalence of food insecurity (X2), stunting (X3), GDP per capita (X4), education (X5), access to decent housing (X6), and smoking (X7).

Table 1. Variable Description

Variable	Description
Life expectancy (Y)	The number of years a newborn will live if faced with the prevailing risk of death in the population at the time the child is born.
Undernourishment (X1)	Prevalence of undernourishment is the proportion of the population in a region whose food consumption is below the energy sufficiency standard for a healthy, active, and productive life.
Food insecurity (X2)	Prevalence of food insecurity is the percentage of individuals in the national population who have experienced or experienced moderate or severe food insecurity at least once in the past 12 months.
Stunting (X3)	Stunting is the prevalence of stunting or very stunting in children under 5 years of age/toddlers.
GDP per capita growth (X4)	Comparison of the increase in the value of gross domestic product (GDP) and population
Education (X5)	Education is the average length of schooling measured by the number of years spent by the population on all types of education they have ever undergone during one year.
Access to decent housing (X6)	A house that meets building safety requirements and minimum building area requirements, as well as the health of its occupants that is affordable for all levels of society.
Smoke (X7)	Residents aged ≥15 who have smoked for one year.

Result and Discussion

Summary Data

The summary of data for all variables used in this study is as follows:

Table 2. Summary Data in Kalimantan

Variable	Obs	Mean	Std. Dev	Min	Max
Life Expectancy	35	71.120743	2.065374	68.03	74.74
Undernourishment	35	11.284	5.752774	2.29	23.01
Food Insecurity	35	2.809772	4.919294	17.4	39
Stunting	35	3.947429	26.6173	-2.9	6.89
GDP Per Capita growth	35	3.947429	2.6173	-2.9	6.89
Uducation	35	8.935429	.716221	7.57	10.17
Access to decent housing	35	70.82	17.31015	46.73	99.16
Smoke	35	26.552	2.684028	21.89	32.64

Table 2 describes the characteristics of the variables used in this study. The lowest life expectancy (min) in Kalimantan was 68.03 years, and the highest life expectancy (max) was 74.74 years. There is a gap in life expectancy between the provinces of Kalimantan. The data summary for Sulawesi is as follows:

Table 3. Summary Data in Sulawesi

Variable	Obs	Mean	Std. Dev	Min	Max
Life expectancy	42	69.13881	2.32814	64.34	72.4
Undernourishment	42	8.977381	3.376932	3.1	18.63
Food insecurity	42	30.95405	5.015061	17.4	41.6
Stunting	42	5.65381	4.068899	-2.34	20.6
GDP Per Capita growth	42	5.65381	4.068899	-2.34	20.6
Education	42	8.874762	.6073261	7.77	9.94
Access to decent housing	42	72.53119	14.55601	47.23	96.6
Smoke	42	28.43143	3.229672	23.35	36.56

Table 3 describes the characteristics of the variables used in this study. The lowest life expectancy (min) on Sulawesi Island was 64.34 years, and the highest life expectancy (max) was 72.4 years. There is a gap in life expectancy between the provinces of Sulawesi Island.

Estimation Results

The results of data analysis using fixed effects are as follows:

Table 4. Estimation Results in Kalimantan

Variable	Coefficient	P Value	Explanation
Undernourishment	-.0690067	0.056	Significant
Food Insecurity	-.022039	0.080	Not Significant
Stunting	-.012764	0.426	Not Significant
GDP Per Capita Growth	-.0107406	0.312	Not Significant
Education	1.868307	0.000	Significant
Access to Decent Housing	.0002634	0.923	Not Significant
Smoke	-.002781	0.912	Not Significant

The analysis presented in Table 4 reveals several interesting pieces of evidence. First, inadequate food consumption, stunting, per capita GDP growth, access to decent housing, and smoking did not significantly affect life expectancy in Kalimantan. Second, food insecurity had a negative and significant impact on life expectancy in Kalimantan. A 1 percent increase in the prevalence of undernourishment reduced life expectancy by 0,06 percent in Kalimantan. Third, education had a positive and significant impact on life expectancy in Kalimantan. A 1 percent increase in education reduced life expectancy by 1,86 percent in Kalimantan. The evidence for Sulawesi is as follows:

Table 5. Estimation Results in Sulawesi

Variable	Coefficient	P Value	Explanation
Undernourishment	-.0228266	0.322	Not Significant
Food Insecurity	-.0045918	0.741	Not Significant
Stunting	-.0121507	0.149	Not Significant
GDP Per Capita growth	.0137109	0.223	Not Significant
Education	1.675729	0.001	Significant
Access to decent housing	.0010321	0.783	Not Significant
Smoke	-.0109076	0.689	Not Significant

The analysis presented in Table 5 reveals several interesting pieces of evidence. First, inadequate food consumption, food insecurity, stunting, GDP per capita growth, access to decent housing, and smoking have no significant effect on life expectancy in Kalimantan. Second, education had a positive and significant effect on life expectancy in Kalimantan. A 1 percent increase in education reduced life expectancy by 1,67 percent in Sulawesi.

This study clarifies that undernourishment has a significant impact on life expectancy in Kalimantan (0.06%), while food insecurity has no significant impact on Sulawesi. These findings are consistent with those of Ma et al. (2024), Barkat et al. (2024), Beyene (2023), and Hassan et al. (2023), who explained that malnutrition causes malnutrition, child mortality, and decreased productivity. Further evidence

suggests that food security has a negative and insignificant effect on life expectancy in Kalimantan and Sulawesi. This finding contradicts those of Djoumessi (2022) and Uchendu (2018), who explained that food security causes mortality and health problems. Evidence has also shown that stunting has a negative and insignificant impact on life expectancy in Kalimantan and Sulawesi. This finding contradicts those of Wright et al. (2023), Wand et al. (2024), and Bukusuba et al. (2018), who explained that stunting contributes to the burden of disease and death in children. Maintaining food security must continue to eliminate the potential for hunger, malnutrition, and health problems, especially in provinces with limited natural resources.

Evidence suggests that GDP per capita growth has a positive but insignificant effect on life expectancy in Kalimantan and Sulawesi. This finding aligns with those of Setyadi et al. (2023). However, this finding differs from those of Paramitha (2018), Kumar and Radulescu (2024), and Wirayuda et al. (2024), who found that GDP per capita has a significant effect on life expectancy. Evidence suggests that education has a positive and significant effect on life expectancy in Kalimantan (1.86) and Sulawesi (1.67). This finding aligns with those of Paramitha (2018) and Wirayuda et al. (2024), who found that education increases life expectancy. Returns on investment in education contribute to better future incomes and health outcomes.

Evidence suggests that environmental factors such as access to adequate housing have a positive but insignificant effect on life expectancy in Kalimantan and Sulawesi. This finding contradicts that of Otavova et al. (2022), who found that living in adequate housing contributes to reduced mortality. Evidence also suggests that poor lifestyle habits, such as smoking, have a negative but insignificant effect on life expectancy in Kalimantan and Sulawesi. This finding contradicts that of Rentería (2015), who explained that smoking was the main variable contributing to mortality.

Conclusion

This study successfully provided crucial evidence to promote food security programs to increase life expectancy in Kalimantan and Sulawesi. Insufficient food consumption can reduce life expectancy in Kalimantan. Meanwhile, education was the dominant variable with a significant influence on life expectancy. Collaboration among the development actors in Kalimantan and Sulawesi is needed to achieve food security and improve educational attainment to increase life expectancy.

Author Contributions Statement

Kurniawan was involved in developing the research concept, searching for relevant literature, collecting and analyzing data, conducting formal analysis, drafting the discussion section, presenting the research findings, and responding to feedback from reviewers. Made Kembar Sri Budhi, I Nyoman Mahaendra Yasa, and Ni Made Tisnawati were involved in reviewing and developing the research concept. Desi Ade Trya collected data and searched for relevant literature. Meanwhile, Henrianto was involved in reviewing, responding to feedback from reviewers, and preparing the editing process.

References

Aljahdali, A. A., Na, M., & Leung, C. W. (2024). Food insecurity and health-related quality of life among a nationally representative sample of older adults: Cross sectional analysis. *BMC Geriatrics, 24*(1). https://doi.org/10.1186/s12877-024-04716-9

Badan Pusat Statistik Indonesia. (2024). *Umur harapan hidup di Indonesia menurut provinsi 2023.*

Barkat, K., Alsamara, M., Mimouni, K., & Jarallah, S. (2024). The effects of food affordability on life expectancy in emerging countries. *Agricultural Economics, 55*(5), 795-822. https://doi.org/10.1111/agec.12850

Beyene, S. D. (2023). The impact of food insecurity on health outcomes: Empirical evidence from sub-Saharan African countries. *BMC Public Health, 23*(1). https://doi.org/10.1186/s12889-023-15244-3

Bukusuba, J., Kaaya, A. N., & Atukwase, A. (2018). Modelling the impact of stunting on child survival in a rural Ugandan setting. *BMC Nutrition*, *4*(1). https://doi.org/10.1186/s40795-018-0220-4

Bloom, D. E., Canning, D., Kotschy, R., Prettner, K., & Schünemann, J. (2024). Health and economic growth: Reconciling the micro and macro evidence. *World Development, 178*, 106575. https://doi.org/10.1016/j.worlddev.2024.106575

Djoumessi, Y. F. (2022). The impact of malnutrition on infant mortality and life expectancy in Africa. *Nutrition*, 103, 111760. https://doi.org/10.1016/j.nut.2022.111760

Firmansyah, A. (2024). Bantuan pangan non tunai dan konsumsi kalori rumah tangga kabupaten grobogan Jawa Tengah: Survei sosial ekonomi nasional maret tahun 2021. *Diponegoro Journal of Economics, 13*(2), 1-15. https://doi.org/10.14710/djoe.43117

Hassan, M., Saif, K., Ijaz, M. S., Sarfraz, Z., Sarfraz, A., Robles-Velasco, K., & Cherrez-Ojeda, I. (2023). Mean temperature and drought projections in Central Africa: A population-based study of food insecurity, childhood malnutrition and mortality, and infectious disease. *International Journal of Environmental Research and Public Health, 20*(3), 2697. https://doi.org/10.3390/ijerph20032697

Kumar, P., & Radulescu, M. (2024). CO2 emission, life expectancy, and economic growth: A triad analysis of Sub-Saharan African countries. *Environment, Development and Sustainability, 27*(5), 11955-11982. https://doi.org/10.1007/s10668-023-04391-7

Ma, H., Wang, X., Li, X., Heianza, Y., Katzmarzyk, P. T., Franco, O. H., & Qi, L. (2024). Food insecurity and premature mortality and life expectancy in the US. *JAMA Internal Medicine*, *184*(3), 301. https://doi.org/10.1001/jamainternmed.2023.7968

Otavova, M., Faes, C., Bouland, C., De Clercq, E., Vandeninden, B., Eggerickx, T., Sanderson, J.-P., Devleesschauwer, B., & Masquelier, B. (2022). Inequalities in mortality associated with housing conditions in Belgium between 1991 and 2020. *BMC Public Health, 22*(1). https://doi.org/10.1186/s12889-022-14819-w

Paramita, S. A., Yamazaki, C., & Koyama, H. (2020). Determinants of life expectancy and clustering of provinces to improve life expectancy: An ecological study in Indonesia. *BMC Public Health, 20*(1). https://doi.org/10.1186/s12889-020-8408-3

Putra, E. P., & Robertus, M. H. (2022). The effect of education level, health level, and income inequality on regency/city poverty level in West Sumatra Province 2016-2021. *Diponegoro Journal of Economics, 11*(2), 115-125. https://doi.org/10.14710/djoe.34324

Rasheed, H., Xu, Y., Kimanya, M. E., Pan, X., Li, Z., Zou, X., Shirima, C. P., Holmes, M., Routledge, M. N., & Gong, Y. Y. (2021). Estimating the health burden of aflatoxin attributable stunting among children in low-income countries of Africa. *Scientific Reports, 11*(1). https://doi.org/10.1038/s41598-020-80356-4

Rentería, E., Jha, P., Forman, D., & Soerjomataram, I. (2015). The impact of cigarette smoking on life expectancy between 1980 and 2010: A global perspective. *Tobacco Control, 25*(5), 551-557. https://doi.org/10.1136/tobaccocontrol-2015-052265

Setyadi, S., Didu, S., Indriyani, L., Kurnia Fitri, A., & Wiidiastuti, A. (2023). Modeling life expectancy in indonesia using system GMM model. *Review of Applied Socio-Economic Research, 25*(1), 83-98. https://doi.org/10.54609/reaser.v25i1.338

Subramaniam, Y., Loganathan, N., & Tang, C. F. (2023). Effect of food security on health in developing countries. *International Journal of Social Determinants of Health and Health Services, 53*(4), 414-423. https://doi.org/10.1177/27551938231163991

Sudharsanan, N., & Ho, J. Y. (2020). Rural–urban differences in adult life expectancy in Indonesia. *Epidemiology, 31*(3), 393-401. https://doi.org/10.1097/ede.0000000000001172

Uchendu, F. N. (2018). Hunger influenced life expectancy in war-torn Sub-Saharan African countries. *Journal of Health, Population and Nutrition, 37*(1). https://doi.org/10.1186/s41043-018-0143-3

Wahyuni, H. (2023). Does food inflation affect infant and child mortality? Evidence from Indonesia. *Jurnal Ekonomi Malaysia, 57*(3). https://doi.org/10.17576/jem-2023-5703-06

Wand, H., Moodley, J., Reddy, T., & Naidoo, S. (2024). Geospatial correlations and variations in child mortality and stunting in South Africa: Evaluating distal vs structural determinants. *Spatial and Spatio-Temporal Epidemiology, 50*, 100653. https://doi.org/10.1016/j.sste.2024.100653

Wirayuda, A. A. B., Otok, B. W., & Chan, M. F. (2024). Comparing life expectancy determinants between Indonesia and Oman from 1980 to 2020. *Journal of Cross-Cultural Gerontology, 40*(1), 29-48. https://doi.org/10.1007/s10823-024-09511-y

Wooldridge, J. M. (2019). *Introductory econometrics: A modern approach*. Cengage Learning.

Wright, C. M., Macpherson, J., Bland, R., Ashorn, P., Zaman, S., & Ho, F. K. (2021). Wasting and stunting in infants and young children as risk factors for subsequent stunting or mortality: Longitudinal analysis of data from Malawi, South Africa, and Pakistan. *The Journal of Nutrition, 151*(7), 2022-2028. https://doi.org/10.1093/jn/nxab054

Yang, Y., Zhao, L., & Cui, F. (2022). How does public health investment affect subjective well-being? Empirical evidence from China. *International Journal of*

Environmental Research and Public Health, 19(9), 5035. https://doi.org/10.3390/ijerph19095035