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# Exploring Stunting in South Kalimantan Province Using R Programming-Based Data Visualization

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**Abstract**

South Kalimantan Province continues to face the challenge of relatively high stunting prevalence despite being endowed with abundant coal resources that could serve as a source of funding for public health. Therefore, this study aimed to examine differences in stunting prevalence among cities, mining districts, and non-mining districts in South Kalimantan to raise stakeholder awareness of disparities across these regional types. This study was conducted between April and December 2024, using secondary data obtained from the Indonesian Ministry of Health and the South Kalimantan Provincial Government. R programming was used to process the data, generate visualizations, and perform analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) tests. Following the significant ANOVA result, Tukey's HSD test was conducted to identify specific regional pairs that differed significantly following the ANOVA result. The results showed that cities had significantly lower mean stunting prevalence than non-mining districts (p-value <0.01). However, the difference between cities and mining districts was not statistically significant (p-value >0.05). Additionally, no significant difference was observed between mining and non-mining districts (p-value >0.05). In conclusion, abundant coal resources in mining districts have not translated into more effective stunting reduction efforts.

**Keywords**: budget, data visualization, public sector accounting, R programming, stunting

## Introduction

Stunting is a condition characterized by a child's length or height falling more than two standard deviations below the median of the World Health Organization Child Growth Standards.[1] Stunting is a complex issue that can not be addressed through public health disciplines alone.[2] Although it primarily falls within the health science domains, it intersects with other fields. Various disciplines, including public sector accounting,[3] public policy,[4] and budgetary systems,[5] play a crucial role in accelerating efforts to alleviate stunting in Indonesia. According to the Indonesian Ministry of Finance, in addressing stunting issues, the government has allocated funding amounting to IDR 48.85 trillion (approximately USD 2.97 billion) through various financial schemes, such as the General Allocation Fund, Specific Allocation Fund, Village Fund, and revenue sharing from both taxes and non-taxes, including mineral royalties.[6]

Indonesia is one of the world's leading coal producers, along with China, India, the United States, Australia, and Russia. In 2023, Indonesia's coal production was projected to exceed that of the United States, Australia, and Russia, while remaining below China and India, approximately 623 million metric tons.[7] The experience of Peru may offer valuable insights into addressing stunting. Peru is rich in natural resources, such as natural gas, oil, and coal, and has integrated revenue from these resources into its national budget to support targeted stunting reduction programs.[8,9]

South Kalimantan Province is the second-largest coal producer in Indonesia.[10] According to the Extractive Industry Transparency Initiative Indonesia, coal production in South Kalimantan Province reached 177.68 million tons in 2021, 202.52 million tons in 2022, and 224.44 million tons in 2023.[10] This advantage enables the South Kalimantan Provincial Government and its district governments under the province to gain more money from the revenue sharing of mineral royalty than their counterparts. However, this economic benefit has not effectively translated into reductions in stunting prevalence across the region. The Ministry of Health showed that the prevalence of stunting in the province was 24.7%, which exceeded the national average of 21.5%.[11] Table 1 presents the prevalence of stunting in each city and district, along with relevant information.

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**Table 1. Stunting Prevalence in Cities/Districts in South Kalimantan, 2023**

| City/District/ Province/State | Population Size 2023[12] | Stunting Prevalence (%) Among Children Aged 0–59 Months | | |
|---|---|---|---|---|
| | | 2021[13] | 2022[14] | 2023[11] |
| Banjarbaru | 268,110 | 19.0 | 22.1 | 12.4 |
| Banjarmasin | 666,440 | 27.8 | 22.4 | 26.5 |
| Kotabaru | 339,060 | 21.8 | 31.6 | 20.1 |
| Tanah Bumbu | 337,330 | 18.7 | 16.1 | 25.1 |
| Tanah Laut | 360,930 | 31.0 | 26.6 | 41.7 |
| Banjar | 591,510 | 40.2 | 26.4 | 30.1 |
| Tapin | 196,470 | 33.5 | 14.5 | 14.4 |
| Hulu Sungai Selatan | 235,980 | 29.1 | 20.3 | 25.4 |
| Balangan | 136,120 | 32.3 | 29.8 | 33.4 |
| Tabalong | 263,400 | 28.2 | 19.7 | 18.1 |
| Barito Kuala | 326,280 | 32.4 | 33.6 | 25.1 |
| Hulu Sungai Tengah | 266,200 | 29.6 | 31.1 | 13.0 |
| Hulu Sungai Utara | 234,510 | 20.9 | 28.0 | 36.0 |
| South Kalimantan Province | 4,222,330 | 30.0 | 24.6 | 24.7 |
| Indonesia | 278,696,200 | 24.4 | 21.6 | 21.5 |

Data source: Statistics Indonesia of Kalimantan Selatan Province and the Indonesian Ministry of Health

The high prevalence of stunting in a province with abundant coal resources is particularly interesting to investigate because the reality turned out to contradict what was expected. According to Article 33, Paragraph 3 of the 1945 Constitution of the Republic of Indonesia, *"The land and waters and the natural wealth contained therein shall be controlled by the state and utilized for the greatest welfare of the people."*[15] However, the abundance of coal resources has not translated into improved welfare for people in South Kalimantan, as reflected by the high prevalence of stunting.

Several studies have investigated stunting in South Kalimantan Province.[16-19] A previous study showed that stunted children were commonly born to adolescent mothers who married early because of unfavorable socioeconomic conditions.[16] Another study examined socioeconomic status, maternal health service utilization, and toddler characteristics and showed that underweight nutritional status is the primary contributing factor to stunting in South Kalimantan Province.[17] Additionally, a study on nutritional intervention programs found no significant correlation between the implemented programs and policy budgeting.[18] Furthermore, a data-driven study highlighted the importance of using local-level data to strengthen public health infrastructure in South Kalimantan Province.[19] However, these studies did not address the role of the province's abundant natural resources in addressing stunting.

Accounting and its subfields, particularly management accounting and public sector accounting, focus on facilitating effective and efficient decision-making, including allocating state and local budgets in the public sector. Accounting researchers and practitioners are increasingly engaging with the Sustainable Development Goals (SDGs),[20] with stunting being identified as a target for elimination by 2030 under Goal 2: End Hunger.[21] However, limited research examined the intersection of stunting with accounting, budgetary data, and data visualization in Indonesia, particularly in South Kalimantan, a mineral-rich province.

This study aimed to analyze disparities in stunting prevalence across cities, mining districts, and non-mining districts in South Kalimantan Province. The findings are expected to provide policymakers with valuable insights into the stunting issue. This study introduced a novel perspective by highlighting the paradox of stunting in resource-rich regions, examining its intersection with budgeting and public sector accounting, and presenting findings through carefully designed data visualization.

## Method

This study used a quantitative descriptive research design, utilizing secondary data analysis. Exploratory data visualization techniques in R were employed to analyze categorical disparities in stunting prevalence across various regions in South Kalimantan. This study was conducted between April and December 2024. South Kalimantan is not only the smallest province on Kalimantan Island,[22] but also one of the largest coal producers in Indonesia,[10] making it a region of particular interest due to its unique socioeconomic profile.

South Kalimantan Province comprises 13 regions, which were categorized into three groups based on regional characteristics: cities, mining districts, and non-mining districts. Banjarbaru and Banjarmasin were classified as cities. The mining districts included Kotabaru, Tanah Bumbu, Tanah Laut, Banjar, Tapin, Hulu Sungai Selatan, Balangan, and Tabalong. The remaining districts (Barito Kuala, Hulu Sungai Tengah, and Hulu Sungai Utara) were categorized as non-

mining districts. Therefore, the main research variable was the stunting prevalence, which was analyzed across the three regional categories, including cities, mining districts, and non-mining districts.

Data were obtained from open sources, specifically the official websites of the South Kalimantan Provincial Government (https://data.kalselprov.go.id/dataset/data/1334)[23] and the Indonesian Ministry of Health (https://layanandata.kemkes.go.id/katalog-data/).[24] Data on stunting prevalence from 2015–2018 were obtained from the South Kalimantan Provincial Government, whereas data from 2019–2023 were retrieved from the Indonesian Ministry of Health. The complete dataset was not available from a single source. Therefore, compiling information from both sources was necessary. Data for 2020 were unavailable because the survey could not be conducted due to the COVID-19 pandemic. The research methods are shown in Figure 1.

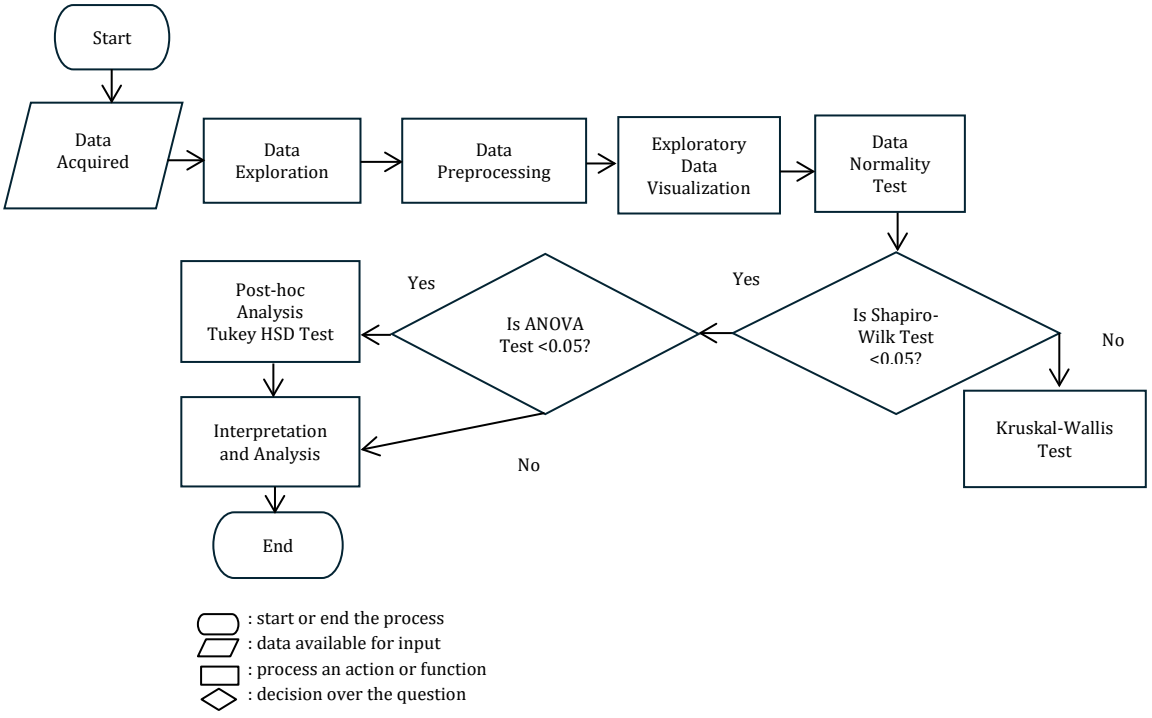


**Figure 1. Research Method Diagram**

A structured, data-driven approach was adopted, beginning with the collection of secondary data from the South Kalimantan Provincial Government and the Indonesian Ministry of Health. The dataset was explored to assess its completeness and consistency, followed by preprocessing to ensure its analytical readiness. Exploratory data visualization was conducted using R Programming, which helped identify patterns and disparities in stunting prevalence across the three regional categories. These preliminary visual insights informed the selection of appropriate statistical tests.

Several visualization techniques from the ggplot2 package in R were used.[25] The geom_line() function was used to illustrate the temporal trends in stunting prevalence for each district. The facet_wrap() function was used to generate individual panels for each regional category to facilitate subgroup comparisons. Additionally, the geom_boxplot() function was used to summarize the distribution of stunting prevalence, showing medians, variability, and outliers. These plots enhanced the understanding of group-level differences.

Data normality was assessed using the Shapiro–Wilk test to determine the correct statistical test.[26] For normally distributed (p-value ≥ 0.05), a one-way analysis of variance (ANOVA) was performed to test for significant differences among the three groups. When ANOVA results were significant (p-value <0.05), a Tukey's honestly significant difference (HSD) test was performed to identify specific pairwise differences. The Kruskal–Wallis test was used as a non-parametric alternative for non-normally distributed data.[26] The final interpretation was based on statistical outcomes and visual analyses.

R programming was selected due to its open-source nature and extensive functionality for statistical analysis and data visualization.[27] Particularly, the ggplot2 package offers a wide range of geometric objects (geoms) and plotting tools, such as geom_line(), facet_wrap(), and geom_boxplot(), which are well-suited for the visualization of complex datasets.[25]

## Results

Geom_line() function was used to visualize the data, the resulting plot appeared visually cluttered, resembling tangled threads. This complexity made it difficult to extract a clear interpretation of the stunting trends across regions (Figure 2, upper panel). The data were then visualized using the facet_wrap() function. Before the 13 regions were grouped into three categories (cities, mining districts, and non-mining districts), each was assigned a distinct color to enhance visual differentiation. This method allowed for a clearer and more interpretable visualization than the previous line plot, thereby facilitating comparison of stunting prevalence both by individual district and across the three regional categories. The results effectively "untangled" the complex visual patterns seen earlier. As shown in Figure 2 (lower panel), cities (represented in purple) had the lowest stunting prevalence compared with mining districts (green) and non-mining districts (yellow).

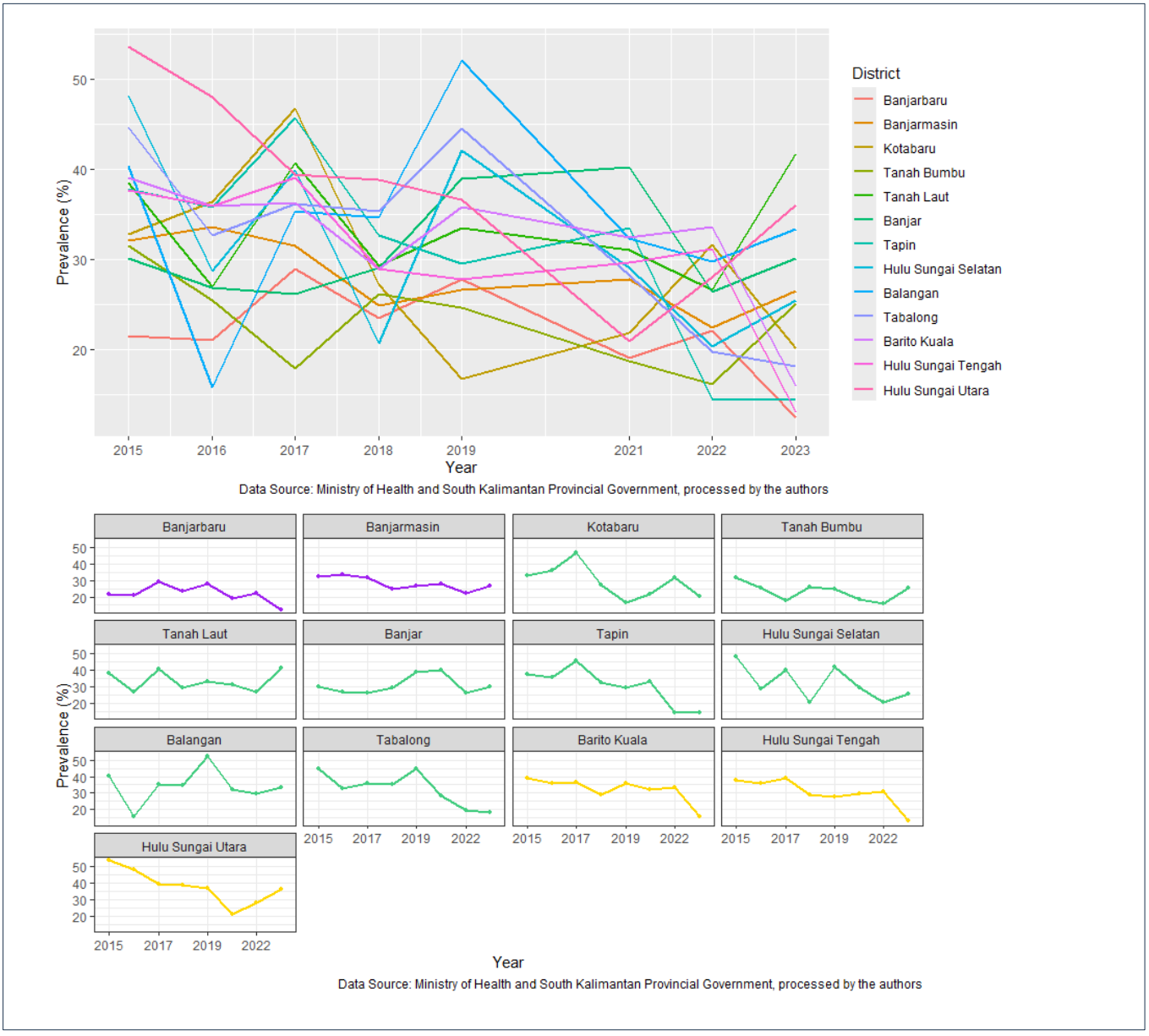


**Figure 2. Exploring South Kalimantan Province Stunting Data Visualization Using geom_line() and facet_wrap() Functions**

The next stage of data exploration was performed using the geom_boxplot() function to generate informative visualizations of stunting prevalence within each regional category. This method provided a clear summary of the data distribution, variability, and central tendency, highlighting the median values for each year across the three categories. The boxplots enabled a more structured comparison of stunting trends over time, providing valuable insight into disparities across the three categorical regions, as shown in Figure 3.

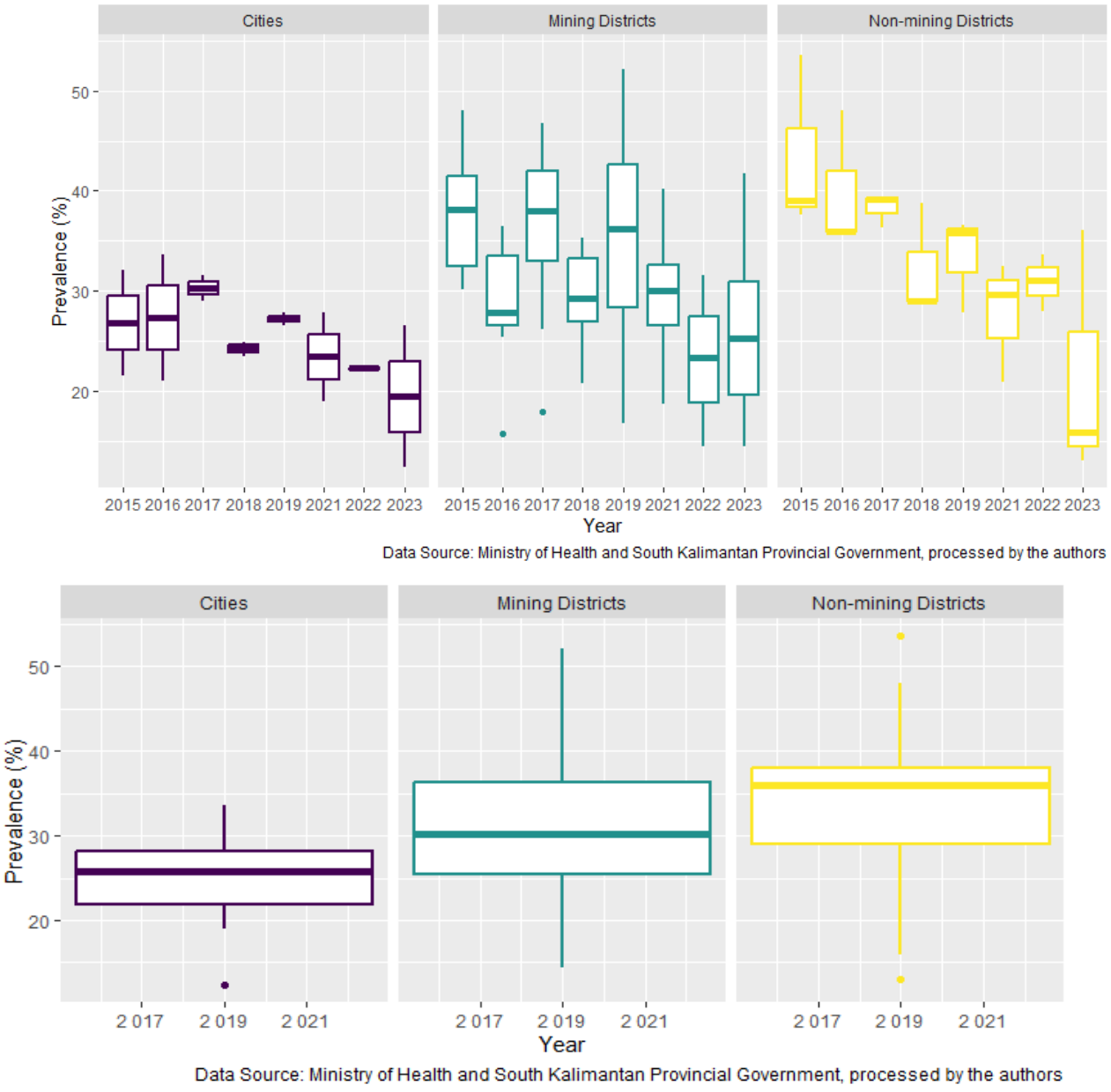


**Figure 3. Comparison of Stunting Prevalence in South Kalimantan Province Among Cities, Mining Districts, and Non-Mining Districts**

R programming enabled the integration of multiple box plots within each regional category into a single comparative visualization, effectively representing the three regional categories. This allowed easy observation and comparison of the median stunting prevalence across cities, mining districts, and non-mining districts, as illustrated in Figure 3 (lower panel). This study was initially intended to conclude at this stage, as the primary focus was on data visualization. Although the visual output revealed noticeable differences in the median stunting prevalence among the three categories, it was unclear whether these differences were statistically significant.

A one-way ANOVA test was performed to statistically examine whether the observed differences among the three groups were significant. The results of the Shapiro–Wilk test (p-value >0.05) confirmed that the data were normally distributed, validating the assumption required for ANOVA. The one-way ANOVA test revealed statistically significant differences in stunting prevalence among the three regional categories, with a p-value of <0.05.

Considering the ANOVA test results, which indicated statistically significant differences in stunting prevalence among the three regional categories, the data were analyzed with Tukey's HSD test to obtain more detailed pairwise comparisons. The results of the analysis showed that the difference in stunting prevalence between cities and mining districts was not statistically significant (p-value >0.05). However, the difference between cities and non-mining districts was statistically significant (p-value <0.05). Interestingly, the difference in stunting prevalence between non-mining and

mining districts was not statistically significant (p-value >0.05) as shown in Table 2. These findings indicated that, despite their differing resource profiles, mining and non-mining districts exhibited similar stunting prevalence.

**Table 2. Tukey's Honestly Significant Difference Test Result**

| Term | Comparison | null. value | Mean Difference | Lower CI | Upper CI | p-value |
|---|---|---|---|---|---|---|
| Category | Mining Districts vs Cities | 0 | 5.614375 | -0.02763344 | 11.256383 | >0.05 |
| Category | Non-Mining Districts vs Cities | 0 | 8.322292 | 1.80746149 | 14.837122 | <0.05 |
| Category | Non-Mining Districts vs Mining Districts | 0 | 2.707917 | -2.12361070 | 7.539444 | >0.05 |

Notes: null.value = 0 (no difference in means between categories); CI = confidence interval

Furthermore, this study explored the data visualization of the ANOVA and Tukey's HSD tests by incorporating the mean stunting prevalence for each category, which was represented by red rhombus symbols (Figure 4). This enhanced visualization facilitated the observation and comparison of the distribution of values within each group, thereby clarifying the statistically insignificant difference in stunting prevalence between mining and non-mining districts.

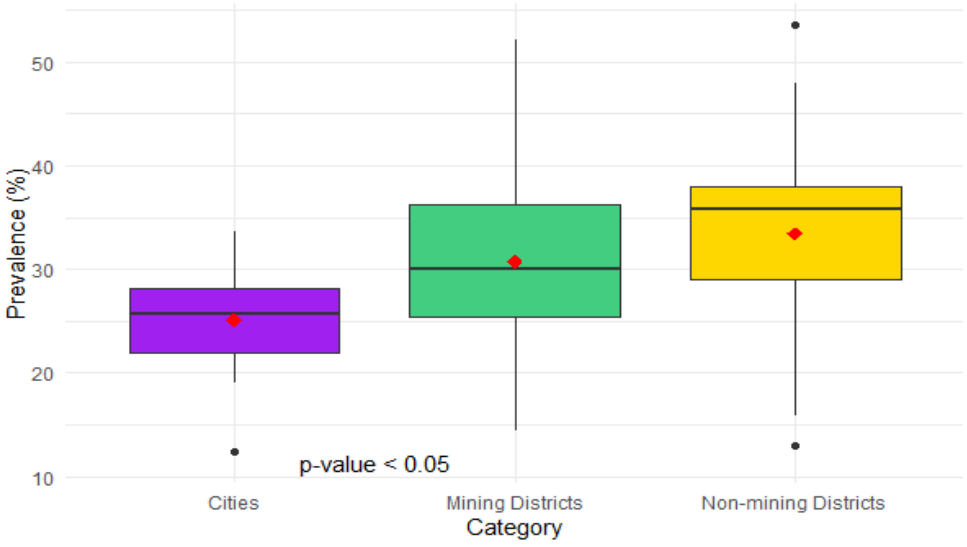


**Figure 4. Further ANOVA Visualization Displaying Both the Median and Mean of Stunting Prevalence**

## Discussion

From a data visualization perspective, R programming proved to be highly effective in untangling complex patterns in stunting prevalence across districts. The use of the facet_wrap() and geom_boxplot() functions in the ggplot2 package allowed for a clearer interpretation of trends, particularly for non-technical stakeholders. Well-crafted visuals are effective tools for communicating scientific findings to a broader audience, including policymakers and the general public.[28] Additionally, by categorizing districts into cities, mining districts, and non-mining districts, and color-coding them accordingly, the visualization strategy helped reveal disparities that might otherwise remain obscured.

Given that non-mining districts generally had more limited financial and infrastructural resources to effectively address stunting, the statistically significant difference in stunting prevalence between cities and non-mining districts was not surprising. However, the absence of a significant difference between cities and mining districts was noteworthy. Cities typically offer greater access to healthcare, education, clean water, and social protection programs, which are well-established determinants of child nutrition and development.[2] Banjarmasin City, which is expected to be an exemplary model of stunting reduction due to its advanced health facilities and educational institutions, has not been able to leverage these advantages and its stunting prevalence effectively has consistently remained above the national average over the past 3 years.[11,13,14]

Surprisingly, the absence of a significant difference in stunting prevalence between mining and non-mining districts, despite the former's economic advantage, presented a paradox that warrants further investigation. This condition indicated that the mere presence of resource wealth did not automatically translate into better health outcomes, underscoring the need for further investigation into the allocation and use of resource-generated revenues in public health interventions. Peru's experience presents a successful example of stunting prevalence reduction.[27] The government implemented targeted

budget interventions through a conditional cash transfer program for families in rural areas, locally known as JUNTOS, with coverage reaching approximately 330 families per 10,000 rural population. This program provided financial assistance to families living below the poverty line, conditional on compliance with specific health and education requirements. The program contributed to a significant reduction in stunting rates by prioritizing vulnerable households, particularly those with children at risk of chronic malnutrition.[29]

The effectiveness of JUNTOS highlights the crucial role of well-designed social protection mechanisms in addressing childhood undernutrition in resource-limited settings.[9] The reduction in stunting prevalence in Peru from 31.3% in 2000 to 11.5 % in 2021,[30] due to its concerted public health and social protection policies.[31] In Indonesia, a similar policy called the Family Hope Program, a conditional cash transfer initiative, was launched in 2007. This program targets the poorest 20% of households nationwide, reaching approximately 10 million beneficiaries in 2020.[32] The cumulative impact of this program has been reported to contribute to a 23% reduction in stunting prevalence.[33] However, comparison of national data from the 2007 Indonesian Basic Health Research[34] and the 2021 Indonesian Nutritional Status Survey,[13] both conducted by the Ministry of Health, showed that the overall decline in national stunting prevalence was only 12.4%. This discrepancy indicates that reliance on the PKH program alone is insufficient. Therefore, complementary budget interventions through other financial schemes, such as regional mineral royalty transfers, village funds, and locally-generated revenue, are necessary for effectively addressing the persistent issue of stunting in Indonesia.

South Kalimantan Province, Indonesia's second-largest coal producer,[10] serves as a textbook example of the "resource curse," where wealth from natural resources fails to translate into improved public health outcomes, highlighting that effective governance and institutional capacity are necessary for better outcomes.[35,36] This argument is further supported by the insignificant difference in stunting prevalence between mining and non-mining districts in this study. Indonesia's fiscal transfer mechanisms, including the General Allocation Fund, Special Allocation Fund, Village Fund, and Revenue Sharing Fund, are intended to reduce disparities in development outcomes, including stunting.[6] However, these funds are not always effectively translated into actionable programs, particularly in regions with weak administrative capacity.[5,37] This study reinforced this viewpoint by demonstrating the disconnect between mining revenue and health outcomes in mining districts in South Kalimantan Province. Public sector accounting plays a vital role. The field increasingly intersects with efforts to meet the SDGs, particularly SDG 2: End Hunger.[20,21] Accounting mechanisms, such as performance-based budgeting and expenditure transparency, can improve the allocation of public resources.[3,38] However, in many Indonesian local governments, budget execution and accountability mechanisms remain weak, often serving elite interests rather than public welfare.[35,36,38]

This study's findings underscore the importance of applying data science in public health. R programming provides a robust and flexible platform for statistical analysis and visualization.[27] Despite its limited adoption in Indonesia, the increasing demand for data-driven decision-making makes R programming a valuable tool for researchers and government analysts. The integration of R programming into higher education, as implemented in other countries[39,40] can strengthen analytical capacity within the public sector and academia.

The strength of this study lies in its innovative use of R programming for data visualization and statistical analysis, which enabled a clearer understanding of the disparities in stunting prevalence across different regions in South Kalimantan Province. Combining visual analytics and inferential statistics provided policymakers with valuable, data-driven insights that are both accessible and actionable. However, this study had several limitations. This study relied solely on secondary data, which may vary in accuracy and consistency across sources and years. Additionally, the cross-sectional nature of this study may limit the ability to infer causality, and other important determinants of stunting, such as household income, maternal education, and sanitation access, which can influence the outcomes, were not considered in the analysis. Future studies should investigate the institutional and policy-level barriers that hinder the conversion of resource wealth into public health improvements. Additionally, comparative studies across other mineral-rich provinces may yield valuable insights into the development of more effective and context-sensitive strategies for stunting.

## Conclusion

The economic benefits have not translated into meaningful reductions in stunting prevalence despite South Kalimantan's abundance of coal resources. Cities exhibit lower stunting prevalence compared to non-mining districts, with no significant difference observed between mining and non-mining districts. These findings indicate systemic challenges in converting resource wealth into effective public health investment. To address this, reforms in resource allocation and stronger budget accountability are needed to ensure revenues are directed toward targeted stunting reduction programs.

**Abbreviations**
SDGs: Sustainable Development Goals; ANOVA: analysis of variance; HSD: honestly significant difference.

**Ethics Approval and Consent to Participate**
Not applicable.

**Competing Interest**
The authors declare that they have no competing interests related to the research, authorship, and publication of this article.

**Availability of Data and Materials**
The authors state that the secondary data is available to anyone interested in this study.

**Authors' Contribution**
MH and MY initiated and conceptualized the study. MH, WN, and MN collected and curated the data. MH and MY performed data visualization and statistical analysis. WN, MH, MN, and MY interpreted the results. MH and MY finalized and edited the manuscript.

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