

The Effectiveness of the BPJS Program and Health Infrastructure which Affects the Infant Mortality Rate in Indonesia in 2023

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Abstract

This study examines the effectiveness of the BPJS Kesehatan Program in reducing infant mortality in Indonesia, especially in the early neonatal period (0–18 days). Although the coverage of BPJS membership has expanded nationally, the AKB is still high and shows disparities between provinces, especially in areas with limited access to health services. Background Problems: The discrepancy between the high coverage of BPJS and the sub-optimal reduction in AKB, especially in disadvantaged areas, is a major issue. The availability of infrastructure and health workers is also still uneven. Contribution: This study simultaneously analyzes the relationship between BPJS membership, health infrastructure, and AKB, a relationship that has rarely been empirically discussed in previous studies. Research Gap: Most previous research has highlighted only one aspect, both social security and infrastructure. The study fills the gap by testing both in a single quantitative model. Research Methods: Multiple linear regression (OLS) was used with secondary data from 34 provinces, accompanied by classical assumption tests for model validation. Findings/Results: BPJS coverage has a negative and significant effect on AKB. The number of health facilities does not have a significant effect, indicating the importance of the quality of services and distribution of medical personnel. Conclusion: The BPJS program plays a role in reducing AKB, but needs to be strengthened through equitable distribution of infrastructure and region-based policies for more equitable and equitable results.

Keywords: BPJS Kesehatan, infant mortality rate, early neonatal, health infrastructure, regional disparities

INTRODUCTION

Health is the main foundation in the development of a nation because it greatly determines the productive capacity of the community and the quality of human resources which are the main drivers of the economy and social welfare. In the context of sustainable development, the health aspect is not only seen as an output of public policies, but also as an important prerequisite (input) for inclusive growth and improved welfare. Among the key indicators of public health, infant mortality rate (AKB) is one of the most important parameters because it reflects the effectiveness of the health care system, socio-economic conditions, and the success of government interventions in providing equitable and quality access to health services (Muldoon *et al.*, 2011).

The early period of life, especially the first thousand days of life (HPK), is a crucial phase that determines the quality of children's growth and development in the future. Various studies have shown that the condition of the baby from birth is highly determined by various factors such as the nutritional status of the mother, access to antenatal services, and the quality of health facilities (Dewanti & Widyantini, 2023). Therefore, the high infant mortality rate in a country can reflect social inequality, low effectiveness of public health policies, and suboptimal cross-sectoral systemic interventions (Islam *et al.*, 2022).

In the context of ASEAN, Indonesia's position in terms of the AKB shows challenges that have not been optimally resolved. Based on UN IGME data (2023), Indonesia's AKB in 2023 was recorded at 19 deaths per 1,000 live births, far behind Singapore (2), Malaysia and Thailand (7), the Philippines (12.8), and Vietnam (17). This shows that although various policies such as the National Health Insurance (JKN) have been rolled out since 2014 to expand public access to health services, the impact on the decline in AKB has not been evenly distributed throughout the region (Erlangga *et al.*, 2019).

Disparitas geografis, ketimpangan distribusi tenaga kesehatan, dan The

limitation of infrastructure in remote areas is the main obstacle in the decline of AKB nationally. In addition, public health literacy, structural poverty, and low levels of education especially for women and pregnant women are determinants that exacerbate these conditions (Sun *et al.*, 2017). Research has also shown that babies born with low birth weight (BBLR) have a higher risk of death, and the incidence of BBLR itself is often closely related to the mother's socioeconomic status as well as limited health services during pregnancy (Dewanti & Widyantini, 2023).

In an effort to reduce the AKB and achieve the Sustainable Development Goals (SDGs) target, especially target 3.2, which is to reduce the AKB to less than 12 per 1,000 live births by 2030, Indonesia must take a systemic and (*evidence-based*) approach. This includes strengthening primary health systems, optimizing the use of real-time data in intervention planning, and integrating policies across sectors such as education, social, and environment. Previous studies have also emphasized the need for better international comparability in measuring AKB so that policies formulated can be more relevant and contextual (Zylbersztejn *et al.*, 2017).

Inequality in the AKB is also very visible domestically. Based on spatial studies, the highest AKB was found in Papua (38.17) and West Papua (37.06), while DKI Jakarta had the lowest rate of 10.4 (Husada & Yuniasih, 2022) and (Delaneira, 2022). This inequality is not only the result of geographical differences, but also of the unequal distribution of health infrastructure and the distribution of medical personnel. Areas in the eastern region of Indonesia generally face limited access, poor road conditions, lack of public transportation, and the distance between residents' residences and health facilities. Study by (Wennemo, 1993) It has even long been emphasized that inequality in infant mortality is very closely related to the distribution of public policies and the government's partiality towards vulnerable groups. This shows that the root of AKB's

problems is not only in medical factors, but also in social injustice and failures in equitable development.

In response to these problems, the Government of Indonesia launched the National Health Insurance (JKN) program through BPJS Kesehatan since 2014, with the aim of expanding health protection for all levels of society. Through this program, every citizen is guaranteed to obtain health services regardless of economic status. As of 2023, membership coverage has reached more than 86% of the national population (Azmi *et al.*, 2024). This program is one of the government's major efforts in bringing health services closer to the poor, especially in overcoming financing. However, the effectiveness of this program is still a debate. Study by (Erlangga, 2018) shows that although access to services has increased, there has been no significant decrease in infant mortality indicators in all regions. Even in separate studies, (Asyary, 2018) stated that primary services that are the spearhead of the implementation of JKN still face quality constraints and unpreparedness of the basic service system. The low competence of health workers, the lack of drugs and medical equipment at the health center, as well as long queues and unfriendly services often make people reluctant to take advantage of the facilities that are already available.

Source: *DataIndonesia.id*

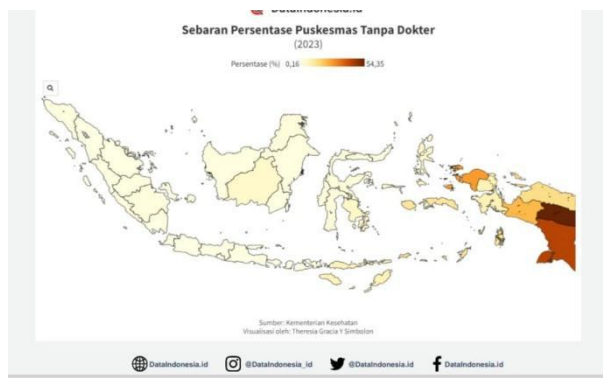
The 2023 picture of the distribution of health centers without doctors from the Ministry of Health illustrates a fairly striking inequality. Areas in the western part of Indonesia such as Java, Sumatra, and Bali seem relatively safe because the majority of health centers already have doctors. However, a different situation can be seen in eastern regions such as Papua, Southwest Papua, Maluku, and East Nusa Tenggara, where many health centers do not have doctors, even in some areas the vacancy rate reaches up to 54.35%. This condition certainly has a serious impact on access to health services, especially for vulnerable groups such as pregnant women and newborns.

This distribution inequality is actually not a new problem. A number of studies show that the uneven distribution of medical personnel is a reflection of weak planning and human resource management in the health sector. (Nurcahyo & Bachtiar, 2020), (Romadhona & Siregar, 2018) mentioned that there are still many health centers in remote areas that have not met the needs of general practitioners according to standards. In fact, this problem is exacerbated by the health information system that is not fully integrated, as revealed by (Idaiani *et al.*, 2023), which found significant disparities in the implementation of health program information systems in various regions.

Instead of being a solution, decentralization actually poses new problems in the management of health workers. (Heywood & Harahap, 2009) call it a phenomenon “*smoke and mirrors*,” where the delegation of authority to the regions is not accompanied by sufficient institutional capacity. As a result, many regions have difficulty in formulating effective health worker distribution policies. On the other hand, research (Mulyanto *et al.*, 2020) shows that the distance and density of health services have a great influence on public access, especially in areas that are geographically difficult to reach. This certainly increases health risks, especially for mothers and children in disadvantaged areas.

Figure 1

Distribution of Percentage of Health Centers (2023)



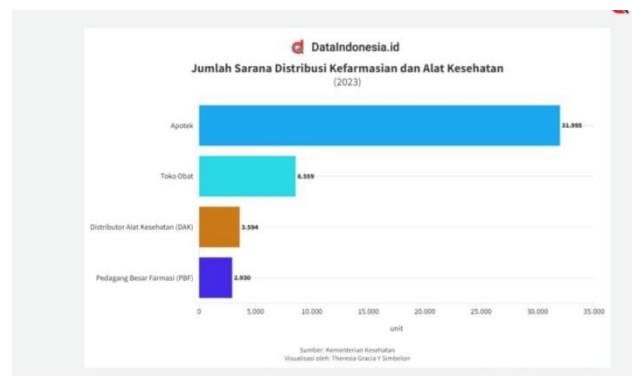
This situation is even more complex when it is associated with the implementation of the National Health Insurance (JKN) program. Although JKN is designed to expand access and reduce the burden of health service costs, the reality is that not all health facilities are able to provide services according to standards. Some hospitals even limit the services of JKN patients because the rates paid by BPJS are not enough for the real cost of services, including for medical procedures such as cesarean section (Ewi *et al.*, 2021). This has a direct impact on the quality of service, especially for mothers and babies who need quick and professional treatment.

Research (Silalahi, 2024) also criticized the implementation of JKN which has been running for a decade but has not shown a profound transformation in primary health services. The changes are still partial and have not touched the broader structural improvements. On the other hand, (Nugraheni *et al.*, 2020) emphasized that even though the cost of childbirth is borne by JKN, there is still a burden of additional costs that must be borne by patients, especially in non-hospital facilities.

These findings show that improving the quality of health services in Indonesia is not enough just by expanding the scope of the JKN program. The government needs to ensure the equitable distribution of medical personnel, strengthen the health information system, and adjust service rates to field conditions. Without a comprehensive overhaul of structural and managerial aspects, the goal of reducing infant mortality evenly throughout Indonesia will be difficult to realize.

Figure 2

Number of Pharmaceutical and Medical Device Distribution Facilities (2023)



Source: DataIndonesia.Id

Based on data from the Ministry of Health in 2023, Indonesia has a total of 31,995 pharmacies, 8,559 drug stores, 3,594 medical device distributors, and 2,930 pharmaceutical wholesalers spread throughout Indonesia. Although this figure is quite large nationally, it does not guarantee the equitable availability of drugs and medical devices in remote areas. This high number is mostly concentrated in major cities and western regions of Indonesia. This inequality in the distribution of pharmaceutical facilities is one of the causes of ineffective health interventions in underdeveloped areas, which ultimately contributes to the high infant mortality rate.

Figure 3

Hospital Bed Ratio per 1,000 Population (2019-2023)



Source: DataIndonesia.Id

Based on the graphic image above, in addition to the limitation of medical personnel and the distribution of medical devices, the limited capacity of hospitals is also a serious obstacle in handling newborns and mothers with complications. Based on data from the Ministry of Health in 2023, the ratio of hospital beds in Indonesia only reaches **1.38 per 1,000 population**, this figure is far below the WHO standard of at least 3 per 1,000. Although it had increased in 2020 when the COVID-19 pandemic was the peak of health services' attention, this ratio has stagnated again in the last three years. The lack of hospital capacity increases the risk of rejection of referral patients, delays in critical neonatal treatment, and high workload for medical personnel. This makes it clear that in addition to financial access through BPJS, the existence and availability of adequate secondary services is also an important factor in reducing infant mortality, especially in the early neonatal period.

On the other hand, the challenges faced are not only structural, but also social. In the context of infant mortality, especially in the early neonatal period (0–18 days), the main causative factors are not only medical conditions at birth, but also complications during pregnancy such as pre-eclampsia, anemia, and infections that are not handled appropriately (Fatimah, 2024). Research (Lengkong *et al.*, 2020) mentioned that the mother's education level, age at childbirth, distance to health facilities, and family economic status are important determinants in determining the survival of the baby. When pregnant women come from poor and poorly educated backgrounds, awareness of pregnancy examinations tends to be low, and often even rely on birth or childbirth shamans without health workers. Further (Rahmawati *et al.*, 2023) underlining that premature babies urgently need continuous intensive care, but the limited neonatal facilities in the region make the risk of death even higher. The absence of an incubator, NICU room, or pediatrician

exacerbates the condition of babies who need immediate care.

Not only that, (Putri & Kartika, 2017) emphasized that public awareness of the importance of pregnancy screening and infant immunization is still low, especially in rural and poor areas. The lack of education about maternal and infant health causes people to often only seek health services when the condition is severe. In fact, the practice of independent midwives that are not supported by modern facilities is actually an obstacle in implementing an ideal referral system (Rahima *et al.*, 2024). In several case studies, such as in Gianyar Regency, Bali, the integration of local policies with the JKN system has been proven to accelerate the decline in AKB if properly monitored (Development *et al.*, 2025). This shows that synergy between the central and regional governments, as well as locally-based innovations, can strengthen the effectiveness of national programs.

All of these findings reinforce the importance of an approach that not only highlights coverage and facility figures, but also considers the social aspects in depth. In this case, the Social Determinant Theory of Health (*Social Determinants of Health Theory*) developed by Sir Michael Marmot melalui WHO *Commission on Social Determinants of Health* (2008) be a strong conceptual foundation. This theory emphasizes that a person's health is determined not only by access to medical services, but also by the social conditions in which the individual is born, raised, lived, and worked. Educational status, income level, living environment, and social supports play an important role in determining an individual's health outcomes. This means that the effectiveness of the BPJS program and health infrastructure will only be optimal if it is accompanied by efforts to overcome social, economic, and educational inequality that is the background of the high infant mortality rate.

By understanding this framework, this research is important to measure the effectiveness of the BPJS Kesehatan program and service infrastructure health

in reducing AKB empirically and holistically. This evaluation will pay attention to social, spatial, and institutional variables that have often been overlooked in the aggregate approach to health policy. With this approach, the research will not only assess in terms of the scope of numbers and physical services, but also examine the quality and fairness of its implementation. The ultimate goal is to formulate public policy recommendations that are not only fiscally efficient, but also socially just, and targeted for the most vulnerable groups in Indonesia.

Problem Formulation

1. How effective is the BPJS Kesehatan Program in reducing infant mortality in Indonesia, especially in the early neonatal period (0-18 days)?
2. Does the equitable distribution of health infrastructure, the availability of medical personnel, and the level of public education have an effect on the effectiveness of the BPJS Kesehatan Program in reducing infant mortality, especially in disadvantaged areas and vulnerable groups?

Purpose

1. To analyze the extent of the effectiveness of the BPJS Kesehatan Program in reducing infant mortality in Indonesia, especially in the early neonatal period (0-18 days).
2. To examine the influence of equitable distribution of health infrastructure, the availability of medical personnel, and the level of public education on the effectiveness of the BPJS Kesehatan Program in reducing infant mortality, especially in disadvantaged areas and vulnerable groups.

Research gap

Various previous studies have attempted to examine the factors that affect the Infant Mortality Rate (AKB) in Indonesia. However, most of these studies still have limitations in comprehensively explaining the relationship between social security systems, health infrastructure, and clinical outcomes such as reduced AKB, particularly in the early neonatal phase which is the most critical period in infant survival. For example, research by Azmi et al. (2024) highlights the effectiveness of the National Health Insurance (JKN) program in expanding access to health services in general. However, this study did not specifically examine its impact on AKB in the early neonatal phase. In addition, the study also did not consider other important variables such as the quality of facilities and the availability of medical personnel, which are actually crucial components of effective neonatal services.

Meanwhile, Laksono et al. (2023) emphasized that there is regional inequality in the use of hospitals, especially in disadvantaged areas. However, their main focus is limited to the issue of physical accessibility to hospitals, without directly linking it to the existence of social security programs such as BPJS Kesehatan. Thus, the synergistic relationship between the scope of BPJS membership and the availability of infrastructure for AKB is still a gap that has not been explained empirically widely. In this context, there have not been many studies that have examined simultaneously how the two factors interact with each other and affect AKB, especially in the early neonatal period.

Other research, such as that conducted by Wenang et al. (2021), discuss geographical gaps in the availability of primary health services in remote areas. However, this study does not explain how these services are integrated with social security systems such as BPJS. Moreover Ewi et al. (2021) highlighted the large contribution of BPJS in financing medical procedures such as cesarean sections, but did not directly link the financing to health outcomes such as a reduction in neonatal mortality. This suggests that most studies still examine these aspects partially, without establishing a unified analytical framework that involves the dimensions of social security and the quality of health infrastructure at the same time.

To answer this gap, this study proposes a quantitative approach that combines two main variables—BPJS membership coverage and the number of health facilities—in a single regression analysis model. With this approach, the research is expected to explain more thoroughly and simultaneously how the two main structural elements of the health system contribute to AKB, particularly in the early neonatal phase. This kind of integrative approach is still rarely practiced in the academic literature in Indonesia and thus makes a new contribution to the development of evidence-based health policy studies.

This research uses a theoretical approach that refers to the *Social Determinants of Health Theory* which was comprehensively introduced by Sir Michael Marmot through a 2008 World Health Organization (WHO) report entitled *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health*. This theory emphasizes that the health of individuals and society is not

solely determined by biological or medical factors, but is also greatly influenced by the social, economic, cultural, and environmental conditions in which a person is born, grows, lives, works, and ages (WHO, 2008).

According to this theory, there are a number of key social determinants that greatly affect public health status, including: (1) the level of education, especially maternal education; (2) economic and employment status; (3) housing conditions and physical environment; (4) access to public services such as clean water and sanitation; (5) social security and social support networks; and (6) geographic access to health services. In the context of infant mortality, these social determinants play an important role as they often affect a family's ability to access and utilize quality health services during pregnancy, childbirth, and neonatal periods.

Furthermore, this theory also states that social inequality results in health inequalities. Inequality in income, education, and infrastructure between urban and rural areas, or between rich and poor groups, will lead to significant differences in health status, including in terms of infant mortality rates. Therefore, efforts to improve public health must be carried out systemically through the improvement of social conditions as a whole, not only through the provision of medical services alone (Marmot et al., 2008). This is in line with the principle of *health equity*, which is justice in health which requires that all individuals have an equal opportunity to achieve the highest degree of health.

In its application to the Indonesian context, this theory provides a strong framework to understand that the high coverage of BPJS program

participation and the availability of health facilities do not necessarily have a significant impact on the decline in AKB, especially if the people who are the target of these services still face other social and structural barriers. For example, a mother who has health insurance but lives in a remote area with poor road access, minimal health facilities, or limited availability of medical personnel, remains at high risk of developing childbirth complications that have an impact on infant death.

Therefore, based on the theory of social determinants of health, this study not only analyzes structural factors such as BPJS coverage and the number of health facilities, but also considers how social factors such as regional inequality, poverty, and education level play a role in strengthening or weakening the effectiveness of health programs. This approach allows for a more comprehensive analysis of the causes and solutions of AKB decline, particularly in the early neonatal phases that are most prone to death.

METHODOLOGY

This study combines two previous researchers, namely by (Azmi et al., 2024), which examines the contribution of the JKN program in expanding access and reducing infant mortality, as well as research by (Ras et al., 2024), which raises the role of the village government in providing basic health services in the midst of limited infrastructure and community participation. Referring to these findings, this study aims to examine the influence of the effectiveness of the BPJS (JKN) program and the availability of health infrastructure on the infant mortality rate (AKB) in Indonesia through a quantitative approach.

This study uses a quantitative approach with the Multiple Linear Regression method through the Ordinary Least Squares technique (OLS) and using data totaling 34 provinces in 2023. This study uses the

multiple linear regression method with the Ordinary Least Squares (OLS) technique for several main reasons. First, OLS allows the measurement of the strength and direction of the relationship between dependent variables (infant mortality rate) and independent variables (number of BPJS participants and number of health facilities) simultaneously, making it suitable for testing the influence of several variables simultaneously. Second, OLS provides efficient and unbiased parameter estimation if the classical assumption of regression is met, so that the results are reliable for quantitative analysis. Third, by transforming variables in the form of natural logarithms ($\ln$), OLS facilitates the interpretation of coefficients as elasticity, which has a clearer economic meaning and helps to overcome the problem of skewness and outliers in the data. Therefore, OLS was chosen as the right method to test the effect of the effectiveness of the BPJS program and the availability of health infrastructure on the infant mortality rate quantitatively. The three variables were analyzed in the form of natural logarithms ($\ln$) to overcome skewness, minimize outliers, and provide a more economically meaningful interpretation of elasticity. The regression model used in this study is formulated in the form of an equation:

$$\ln(AKB_i) = \beta_0 + \beta_1 \ln(BPJS_i) + \beta_2 \ln(FKS_i) + \varepsilon_i$$

Where:

AKB_i = Infant mortality rate

$BPJS_i$ = Number of BPJS participants

FKS_i = Number of health facilities

ε_i = Error term

β_0, β_1 dan β_2 = Parameter estimasi model

$\ln$ = Natural logarithm

The type of data used is secondary data in the form of cross-section aggregate data obtained from 34 provinces in Indonesia. The data is collected from official sources, namely the Central Statistics Agency (BPS) report. The data includes three main variables, namely infant mortality rates (per

1,000 live births), total BPJS participants per province, and the number of health facilities (including hospitals, health centers, and clinics). And to ensure the reliability of the regression model used, this study conducted a classical assumption test which included a residual normality test (with skewness-kurtosis) to ensure a normally distributed residual distribution, a multicollinearity test (using the VIF value) to ensure that there is no high correlation between independent variables, and a model specification test using the Ramsey RESET Test to ensure that the model shape is correct. The results of the three tests showed that all assumptions were met, so the multiple linear regression model in this study was valid and could be used for further analysis.

RESEARCH HYPOTHESIS

H1: Stating that the number of BPJS Kesehatan participants and the availability of health infrastructure affect the infant mortality rate in Indonesia.

RESULT AND DISCUSSION

Statistik Deskriptif

Tabel 1. Statistik Deskriptif

Variable	Obs	Mean	Std. Dev.	Min	Max
provinc	0	-	-	-	-
akb	34	201.7059	26.17254	160	292
fks	34	296.2353	248.6146	110	1100
bpjs	34	7,372,059	10,300,000	1,100,000	43,000,000

The results of descriptive statistics show that the basic health indicators between provinces in Indonesia are very different. The infant mortality rate (AKB) was recorded at an average of 201.71 deaths per 1,000 live births, with a standard deviation of 26.17. In terms of achieving basic health outcomes, there are significant differences between regions, with a minimum score of 160 and a maximum score of 292. This variation shows large differences in the quality and access of health services across provinces.

However, with a very high standard deviation, which is 248.61, the number of health facilities (FKS) per province averages 296 units, with a range from 110 to 1,100 units, indicating that some regions are still experiencing significant shortages of health service infrastructure. Errors in the distribution of these facilities can exacerbate service gaps, especially in areas with many customers.

But in terms of health insurance, the average number of BPJS participants is 7.37 million people per province; However, there are many differences in the distribution of participants, ranging from 1.1 million people to 43 million people. This shows that, although BPJS coverage nationally appears to be large, its reach is still geographically uneven. Although administratively included in the health insurance program, some regions still face problems getting the service.

Overall, the three main variables AKB, health facilities, and BPJS membership show that the national health system experiences structural and geographical differences. To achieve the goal of inclusive and equitable health development, this imbalance is a major obstacle. As a result, to close the gap and accelerate the achievement of national health targets, policy interventions that are more in line with local conditions are needed.

Mutiple Linear Regression

Table.2 Regression test

Variable	Koefisien	Std. Error	t-Statistic	P-Value	95% Confidence
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					Interval
ln(fks)	-0,0375	0,0331	-1,13	0,266	[-0,1050 ; 0,0301]
ln(bpjs)	-0,0439**	0,0225	-1,96	0,059**	[-0,0897 ; 0,0019]
Intersep	6,1756	0,3335	18,52	0,000	[5,4954 ; 6,8558]

Persamaan Model Regresi

$$\ln(AKB) = 6,1756 - 0,0375 \cdot \ln(FKS) - 0,0439^{**} \cdot \ln(BPJS)$$

Information:

1. AKB = Infant Mortality Rate
 - FKS = Number of Health Facilities
 - BPJS = Health Insurance Membership
1. ** shows significance at the level of 5%

The results of multiple linear regression estimates shown in Table 1 show several important findings in the context of the influence of health factors on infant mortality rate (BCA) in Indonesia. This model is arranged in a natural logarithmic (log-linear) form to capture the sensitivity of percentage changes between variables.

First, the BPJS membership variable (lnbpjs) showed a regression coefficient of -0.0439 and was statistically significant at a significance level of 10% (p-value = 0.059). The interpretation of this coefficient is that any 1% increase in coverage BPJS participation in an area

was associated with a decrease in infant mortality by 0.0439%, ceteris paribus. These findings confirm that the national health insurance program has a significant contribution to improving public health indicators, especially related to infant survival.

Second, the variable number of health facilities (lnfks) showed a negative coefficient of -0.0375, but it was not statistically significant (p-value = 0.266). Although the direction of the relationship between health facilities and AKB is in accordance with theoretical expectations that is, the more health facilities, the more AKBs tend to decrease the strength of the relationship in this model is not strong enough to be statistically significant. This can be caused by variability in facility quality, geographical distribution, or operational constraints such as a shortage of medical personnel.

Furthermore, the R-squared value of 0.1900 indicates that about 19% variation in the logarithm of infant mortality rates can be explained by the independent variables included in the model (lnbpjs and lnfks). The remaining 81% is influenced by other variables not observed in this model, such as nutritional status, sanitation, health behavior, or other social determinants.

Test the significance of the model as a whole (F-statistic = 3.64; Prob > F = 0.0382) shows that the regression model is constructed significantly at the rate of 5%. This means that the combination of BPJS membership coverage and the number of health facilities together has an influence on the infant mortality rate in Indonesia.

Overall, this model provides an empirical picture that systemic interventions in the form of health insurance expansion have a more significant impact on lowering AKB than simply increasing the number of physical facilities without paying attention to their quality, distribution, and carrying capacity. These findings can be strategic inputs in policy planning national health, especially in the context of primary health system reform that is more equitable and

responsive to the needs of vulnerable communities.

Classic Assumption Test

1. Normality

Table 3: Test skewness-kurtosis

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	Adjusted $\chi^2(2)$	*p-value
r	34	0.5521	0.5877	0.67	0.7136

The residual normality test is a crucial stage in ensuring the validity of the classical linear regression model. This assumption is important because it is the basis for the validity of subsequent statistical testing. In this study, the skewness and kurtosis approaches were used simultaneously to evaluate the form of residual distribution. The test results showed that the p value for skewness was 0.5521 and for kurtosis was 0.5877. Meanwhile, the adjusted chi-square value is 0.67 with a p-value of 0.7136. All of these values are well above the significance threshold of 0.05, which indicates that the residual distribution does not deviate from normality. Thus, it can be concluded that the model has met the assumption of normal distribution on its residuals, so that the results of further estimation and testing can be carried out with a high degree of confidence.

1. Multikolinearitas

Table 4: Test VIF

Variable	VIF	1/VIF (Tolerance)
Inbpjs	1.11	0.898
Infks	1.11	0.898

A condition in which two or more independent variables in a regression model have a high correlation with each other is called multicollinearity. This condition can lead to instability in the estimation of the coefficient and a decrease in the accuracy of the interpretation of the results. The Variance Inflation Factor (VIF) test is used to identify potential multicollinearity in this model.

The test results showed that the two independent variables, namely BPJS membership (Inbpjs) and the number of health facilities (Infks), had the same VIF value of 1.11. This value is well below the commonly used threshold of 5, indicating that there is no indication of disruptive multicollinearity in the model. In addition, the tolerance value or 1/VIF for both variables is 0.898, which indicates that almost 90% of the variation in each variable is not explained by the other variables in the model.

With a mean VIF value of 1.11, it can be concluded that this model does not experience multicollinearity problems, and the relationships between independent variables do not change the results of regression estimation. As a result, the results of subsequent regression analysis can be considered valid and reliable.

1. Model Specifications

Table 5: Ramsey RESET

Null Hypothesis (H_0)	Test Statistic (F)	Degrees of Freedom	*p-value	Conclusion
Model has no omitted	2.57	(3, 28)	0.0746	Fail to reject H_0

variable
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p-value of 0.0746, the Ramsey RESET test shows that the linear regression model with logarithmic transformations in the variable number of BPJS participants and health facilities is still statistically acceptable.

However, p-values close to the significance limits suggest that the model may still not understand all the complexity of the data. Nonlinear relationships or other important variables may not have been included. This simple model may overlook important aspects that affect infant mortality rates in Indonesia, as the contexts are very diverse socially and geographically.

Regresi Linear Double Robust

Table 6: Test Regresi ro

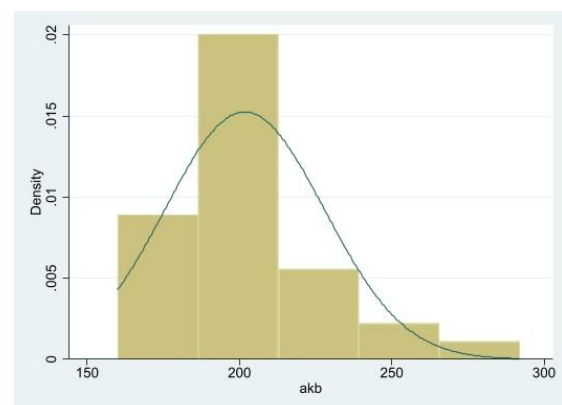
Variable	Coefficient	Robust Std. Error	t-statistic	p-value	95% CI Lower	95% CI Upper
<i>Infks</i>	-0.037	0.024	-1.59	0.123	-0.086	0.011
<i>Inbpjs</i>	-0.044*	0.021	-2.09	0.044*	-0.087	0.001

The regression results showed that the increase in BPJS Kesehatan coverage significantly contributed to the reduction of infant mortality in Indonesia. A negative coefficient of -0.044 and a p-value of 0.044 at a significance level of 5% indicate that the expansion of public health insurance has a real impact on improving children's health outcomes. Meanwhile, the number of health facilities shows a negative but not statistically significant influence, which indicates that the existence of physical infrastructure alone is not enough to reduce

infant mortality without improving the quality of services.

Although not high, the model contributes significantly to the 19 percent variation in infant mortality between provinces, as shown by the R² value of 0.19. These results underscore that improved quality of primary services, equitable distribution of health workers, and a more comprehensive approach to the social determinants of health should support social security-based interventions. To improve understanding of the variables that affect infant mortality, the model can be improved by including variables such as sanitation, maternal education, health expenditures, and the ratio of medical personnel. To achieve sustainable development targets, especially the reduction of infant mortality, there needs to be strong cooperation between the expansion of social protection and the transformation of the health care system. The implications of his policies show this.

Histogram Analysis of Density Distribution



The histogram shows a multimodal data distribution with three dominant peaks around the value of 1.00; 2.00; and 3.00. A wide value between 0.05 and 3.00 indicates a high level of internal variation, while a swipe to the right indicates a concentration of data at a higher value. This pattern indicates a heterogeneous population structure, with the possible presence of subgroups with unique

characteristics. This shows inequalities in access, risk, and behavior between groups in social, economic, and public health contexts.

Due to the lack of fulfillment of the model's basic assumptions, this abnormal and non-unimodal distribution challenges the use of conventional statistical methods such as OLS regression. Therefore, to thoroughly identify structural dynamics in the data, nonparametric methods or mixed models are used. In addition, more reliable results can be generated by techniques devoted to handling complex distribution and extreme values, such as extreme value analysis focused on distributions. In order to produce accurate, representative, and relevant estimates of non-uniform population conditions, it is essential to choose the right method.

Discussion

This study aims to identify and analyze the main determinants that influence infant mortality rate (AKB) in Indonesia, focusing on social, economic, and access to health care variables. Findings from the regression analysis showed that a number of variables, such as health insurance ownership, availability of health facilities, income levels, and health care seeking behaviors by mothers, were significantly correlated with infant mortality. These results underscore the importance of comprehensive, evidence-based policy interventions to address the complexity of determinants of child health in developing countries.

One of the main findings of this study is the significant role of health insurance in reducing infant mortality. The National Health Insurance (JKN) program has proven to contribute positively to expanding public access to essential health services, especially maternal and neonatal. Research by (Anindya *et al.*, 2020) shows that the existence of JKN has succeeded in reducing the access gap between socio-economic groups,

increasing the utilization of maternal and child health services, and having a direct impact on reducing AKB. Consistently, studies by (Aziz *et al.*, 2022) in Pakistan also concluded that children covered by health insurance tend to have better health status due to increased frequency of pregnancy checkups, safer childbirth, and more intensive postnatal surveillance.

In addition to health insurance coverage, the availability and density of health care facilities play a crucial role in lowering infant mortality. Regions with better access to hospitals, clinics, and medical personnel tend to record lower infant mortality rates. (Mulyanto *et al.*, 2020) emphasizing that the density of health services not only increases geographical affordability, but also accelerates response times in emergencies, especially for mothers and babies. In a decentralized health system such as in Indonesia, the quality and availability of services vary greatly between regions, so disparities in the provision of health infrastructure can exacerbate public health inequalities. Study by (Scholz *et al.*, 2015) and (Laksono *et al.*, 2023) It also emphasized that physical infrastructure and the number of medical personnel greatly influence children's health outcomes, especially in a broad and heterogeneous geographical context.

Socioeconomic factors, especially poverty levels and per capita income, also show a significant influence on AKB. Areas with low income levels and high poverty rates tend to have limited access to adequate nutrition, decent housing, and quality health services. These findings are in line with research (Subramaniam *et al.*, 2018). which underlines that poverty is at the root cause of various health risks in babies, including low birth weight, malnutrition, and lack of medical control during pregnancy. (Hodge *et al.*, 2014)

and (Suparmi *et al.*, 2018) adding that wealth inequality between regions coupled with unequal distribution of infrastructure creates a vicious circle of inequality that is difficult to break without strong and sustainable state intervention.

Maternal health-seeking behaviors, such as frequency of antenatal visits (ANC), choice of delivery venue, and tendency to seek medical help when the baby is sick, have also been shown to be important factors influencing AKB. According to (Khasanah *et al.*, 2023), This behavior is greatly influenced by the level of education, social norms, and perception of health services. In addition, changes in national health policies also affect the dynamics of these behaviors. (Kosasih *et al.*, 2022) noted positive changes in the pattern of seeking health services by mothers after the implementation of Universal Health Insurance (UHC), which shows that institutional improvements can increase individual responsiveness in accessing children's health services more optimally.

The regression model used in this study has been tested through various diagnostic tests to ensure its validity and reliability. The residual normality test showed that the data was distributed normally, in accordance with the prerequisites of the classical linear regression model Variance Inflation Factor (VIF) indicating that there was no high correlation between independent variables that could distort the estimated coefficient. Furthermore, model specification tests through the Ramsey RESET method showed that the functional shape of the model was appropriate, strengthening the reliability of the interpretation of regression parameters (Christodoulou-Volos, 2023). Thus, the model has a solid basis for providing statistically valid inferences.

These findings have important policy implications. The Indonesian government needs to expand health coverage, especially in rural areas and

disadvantaged areas, to ensure that all mothers and children receive quality health services. In addition, improving and equitable distribution of health infrastructure, both in terms of physical and human resources, must be a priority in national health development policies. Community-based interventions that aim to improve maternal awareness and behavior in maintaining infant health also need to be strengthened through ongoing education and training. With an integrated and evidence-based policy approach, Indonesia has the potential to significantly reduce infant mortality and achieve sustainable development targets in the health sector.

CONCLUSION

Spatial analysis shows the inequality of the distribution of infant mortality rate (IMR) between provinces in Indonesia. Regions with the highest IMR – such as West Sulawesi, Papua and West Papua – generally have BPJS coverage and a low number of health facilities. These findings corroborate the results of previous regressions, where logarithmic increases in health facilities and social security coverage were associated with significant decreases in infant mortality.

This spatial gap reflects that not all regions have equal access to health services. The glaring disparities in the provision of infrastructure and health insurance are not just administrative problems, but show systemic inequities in the distribution of basic services. This condition is in line with the histogram results which show a multimodal distribution and a skew to the right, indicating population heterogeneity and the possibility of subgroups of regions with different characteristics.

Thus, an analysis approach that does not consider distribution structure and geographic context risks simplifying the complexity of the data. These findings underscore the importance of health policies that are adaptive to regional

conditions not just based on national averages. Region-based interventions are key to ensuring that the reduction of infant mortality can be achieved equitably, in line with the principles of justice in the national health system.

Conclusion

The results of this study show that the BPJS Kesehatan program has a real influence in reducing the infant mortality rate (AKB) in Indonesia, especially in the early neonatal period. Regression analysis conducted on data from 34 provinces shows that the wider the coverage of BPJS membership, the lower the infant mortality rate recorded in a region. These findings confirm the importance of the existence of health social security that is able to provide protection for all levels of society, especially vulnerable groups such as pregnant women and newborns. However, this success is still partial and uneven across provinces, as there is a sharp disparity between the western and eastern regions of Indonesia in terms of availability and quality of health services. The number of health facilities did not have a significant effect on the decline in AKB. This indicates that the existence of physical facilities alone is not enough if it is not supported by the quality of services, the adequacy of medical personnel, and the readiness of neonatal health equipment. Many areas administratively have health facilities, but are not equipped with the doctors, midwives, or basic medical equipment necessary for the treatment of critical infant conditions. As a result, neonatal services that should be responsive and quality cannot be carried out optimally, thus reducing the effectiveness of medical interventions in cases of infant death.

In addition to structural factors, this study also highlights that social and economic aspects also affect the success rate of the BPJS program in suppressing AKB. The level of maternal education, household economic conditions, distance and access to health facilities, as well as public awareness of the importance of pregnancy screening and immunization are

determining factors that cannot be ignored. In many areas, there are still traditional childbirth practices that are not accompanied by medical personnel, low visits by pregnant women to health centers, and public ignorance of the symptoms of high-risk pregnancy and neonatal complications. This condition reinforces that efforts to reduce AKB cannot only rely on health financing, but must be accompanied by a social approach, appropriate education, and the development of a health system that is inclusive and adaptive to local conditions.

Thus, it can be concluded that BPJS Kesehatan is one of the important instruments in efforts to reduce infant mortality in Indonesia, but its effectiveness depends heavily on other supporting factors. The success of this program will not be optimal if it is not accompanied by equitable distribution of service infrastructure, improvement of the quality of health workers, and handling of social factors that affect people's behavior and access to health services. The government needs to review the implementation strategy of this program so that it is not only oriented to coverage numbers, but also able to respond to the concrete needs of the community, especially in areas with a high health burden and limited resources.

Suggestion

Looking at the results and findings of this study, it is very important for the government and related stakeholders to not only focus on expanding the coverage of BPJS administratively, but also pay attention to the quality of services available in the field. Efforts to reduce infant mortality must be carried out comprehensively, namely by improving the distribution of medical personnel, building adequate neonatal facilities in underdeveloped areas, and ensuring that every health facility has the capacity to handle critical conditions in newborns.

In addition, there is a need to increase education to the community, especially pregnant women and families

living in remote areas, so that they understand the importance of pregnancy screenings, immunizations, and medical treatment from an early stage. The involvement of community leaders and local health workers in health counseling can be an effective strategy to reach communities that have not been touched by formal services. No less important, the government needs to strengthen the referral system and medical transportation, so that patients from remote areas can be treated immediately when they need follow-up treatment.

Supervision of the implementation of the BPJS Kesehatan program must also be improved. Many health facilities face obstacles in financing due to service rates that do not match the real cost, so it has the potential to reduce the quality of service. Therefore, the evaluation of the financing system and tariff feasibility must be carried out periodically and transparently. A reduction in infant mortality will only occur if all aspects of structural, social, and administrative are managed in an integrated and fair manner. The government must ensure that every baby born in Indonesia, regardless of region or social background, has an equal and decent chance at life. With the right commitment and policies, the BPJS Kesehatan program will not only be a financial protection tool, but also the main pillar in building the nation's health future.

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