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Mapping and Analysis of Stunting Risk Factors in East Java

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Abstract

The prevalence of stunting in East Java Province was recorded at 17.7%, where this figure has been below the maximum limit of the WHO stunting prevalence, but still has not reached the Ministry of Health's performance target. The purpose of this study is to provide information about the distribution of stunting cases and their risk factors visually through maps, as well as to identify factors that affect the prevalence of stunting in East Java Province in 2023. This study uses a quantitative research design with cross sectional. The population in this study is districts/cities in East Java Province in 2023, which is 38 districts/cities. The sample in this study is the entire total population. The analysis used was multiple linear mapping and regression, using GeoDa software. The mapping results showed that the highest prevalence of stunting was found in Jember Regency, Lumajang Regency, Probolinggo Regency, and Probolinggo City. The results of the multiple linear regression test showed that the percentage of exclusive breastfeeding in infants < 6 months significantly (p=0.01227) had an effect on reducing the prevalence of stunting. Population density (p=0.09750), number of posyandu (p=0.94130), percentage of households with access to healthy latrines (p=0.76093), and number of villages/sub-districts with 5 STBM pillars (p=0.9414) did not have a significant effect on reducing the prevalence of stunting. It is hoped that the results of this study can be used to develop more effective intervention programs in reducing the prevalence of stunting in East Java Province, such as focusing on exclusive breastfeeding in 1,000 HPK.

Introduction

Stunting in Indonesia, especially in children, is a complex clinical condition with long-term impacts. The definition is chronic malnutrition that arises due to insufficient nutrition over a long period of time, especially in the First 1000 Days of Life (HPK) from conception or early pregnancy to 2 years of age, which has an impact on growth disorders and is characterized by a child's lower height for his age (Matahari et al., 2022; Dewi, 2022). Stunting is always preceded by a slowdown in weight gain (Maliati, 2023) weight faltering) which can occur from in utero and continue after birth. Research in Malawi shows that babies born shorter will continue to experience length faltering during infancy (Samsuddin et al., 2023)

Prenatal factors, such as maternal nutrition during pregnancy and postnatal factors, such as the child's nutritional intake during the growth period, socioeconomic factors, exclusive breastfeeding, infectious diseases, health services, and other factors. The factors that cause stunting according to Adriani et al. (2022) are food intake, infectious diseases, parenting, health services and environmental sanitation, economic factors, socio-cultural factors, education, environmental factors. Various studies state that stunting is one of the main causes of death in

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toddlers in the world and can have an impact on the low quality of life in the future. Ultimately, stunting can hinder economic growth, increase poverty and widen inequality (Adriani et al., 2022; Samsuddin et al., 2023; Sekretariat Wakil Presiden Republik Indonesia, 2017).

According to the 2023 Indonesian Health Survey (SKI), it is stated that the prevalence of stunting in Indonesia has decreased by 0.1% compared to the Indonesian Nutrition Status Study (SSGI) in 2022, which is 21.5%. However, based on WHO criteria, the prevalence is still classified as high, which is >20%. The prevalence of stunting in East Java Province recorded in SKI in 2023 is 17.7%, where this figure has been below the maximum limit of WHO stunting prevalence, but still has not reached the Ministry of Health's performance target for 2022 – 2024, for 2023. The prevalence of stunting cases is still a serious issue, because stunting conditions can make children at higher risk of suffering from non-communicable diseases in adulthood such as diabetes mellitus, cancer, heart, hypertension, and others (Kementrian Kesehatan, 2016; Nabila & Andriani, 2023; Kemenkes RI, 2022; Kemenkes, 2022).

The Indonesian government must be committed to reducing the prevalence of stunting and needs to work with all parties. The acceleration of the handling of stunting cases in a region is highly dependent on the dissemination of public information about the prevalence of stunting. One way to accelerate handling and prevention in the health sector is by using geographic data through the Geographic Information System (GIS). The data can be described or mapped according to the distribution from the district/city area to the sub-district/village area using GIS. This study aims to provide information about the distribution of stunting cases and their risk factors visually through maps, as well as identify factors that affect the prevalence of stunting in East Java Province in 2023 (Tajuddin & Wini, 2022; Lestari et al., 2023; Saputra et al., 2020).

Methods

This study employed a quantitative research approach with a cross-sectional design aimed at analyzing the distribution and determinants of stunting in East Java Province. The study population encompassed all administrative districts and cities within the province, totaling 38 regions. Since the unit of analysis was at the regional level, the entire population was included, making this a census-based study rather than a sample-based one. The use of a total population approach ensured comprehensive coverage and robust comparison across all areas.

The research relied solely on secondary data, which were sourced from two main government publications: the 2023 Indonesian Health Survey (SKI), issued by the Ministry of Health of the Republic of Indonesia, and the 2023 East Java Provincial Health Profile, published by the East Java Provincial Health Office. These documents provided up-to-date and credible statistical data on health indicators relevant to stunting and its associated factors.

The dependent variable in this study was the prevalence of stunting among children under five years of age in each district or city in East Java in 2023. The independent variables included several contextual and health service indicators hypothesized to influence stunting. These were: (1) population density (people per square kilometer), (2) the number of integrated health service posts (posyandu), (3) the percentage of infants under six months who were exclusively breastfed, (4) the percentage of households with access to healthy sanitation facilities (healthy latrines), and (5) the number of villages/sub-districts implementing the five pillars of the Community-Based Total Sanitation (STBM) initiative.

Data analysis was conducted using GeoDa, a spatial analysis software. The analysis was two-fold. First, spatial mapping was employed to visually illustrate the geographic distribution of stunting prevalence and associated variables across districts and cities. These thematic maps facilitated the identification of regional disparities and potential clusters of high or low prevalence. Second, multiple linear regression analysis was performed to evaluate the statistical

relationships between the independent variables and the stunting prevalence. This step aimed to quantify the extent to which each factor contributed to explaining variations in stunting rates.

Prior to the regression analysis, classical assumption tests were carried out to ensure the validity of the model. These included tests for normality (Shapiro-Wilk), multicollinearity (condition index and variance inflation factor), and heteroscedasticity (Breusch-Pagan test). All diagnostic results indicated that the data met the necessary assumptions for reliable regression analysis.

Result and Discussion

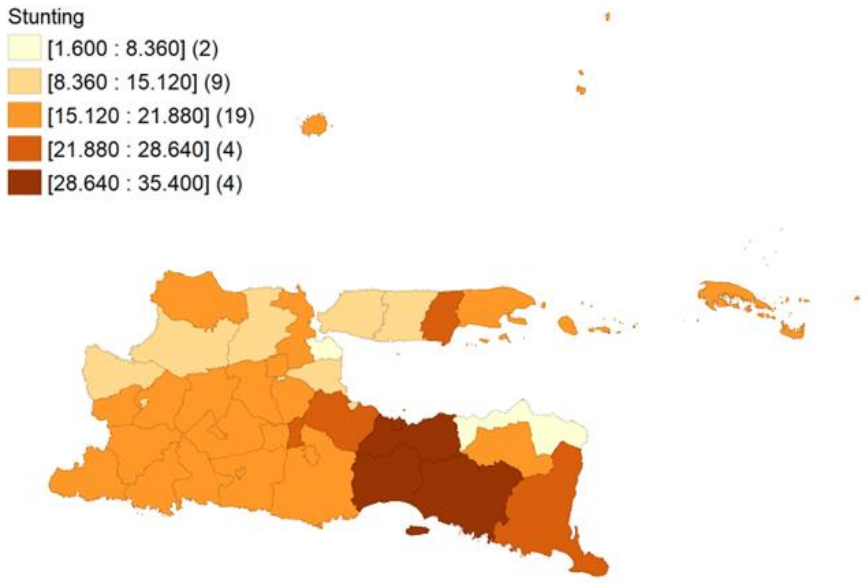

Figure 1. Distribution Map of Stunting Case Prevalence in East Java Province

The distribution map in figure 1, is a map grouped into 5 groups with the same interval. The highest prevalence of stunting in East Java Province in 2023 is found in Jember Regency (29.7%), Lumajang Regency (29.9%), Probolinggo City (31.8%), and Probolinggo Regency (35.4%), while the lowest prevalence is found in Situbondo Regency (4.1%) and Surabaya City (1.6%).

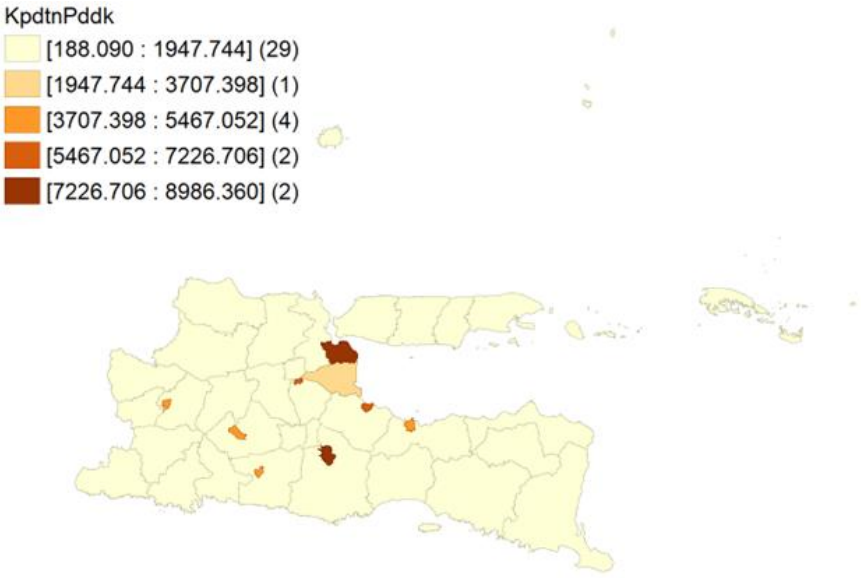

Figure 2. Map of Population Density Distribution in East Java Province

Based on the distribution map in figure 2, there are not many areas in East Java Province that have a high population density. The districts/cities with the highest population density are Malang City (8,068.47 people/km2) and Surabaya City (8,986.36 people/km2).

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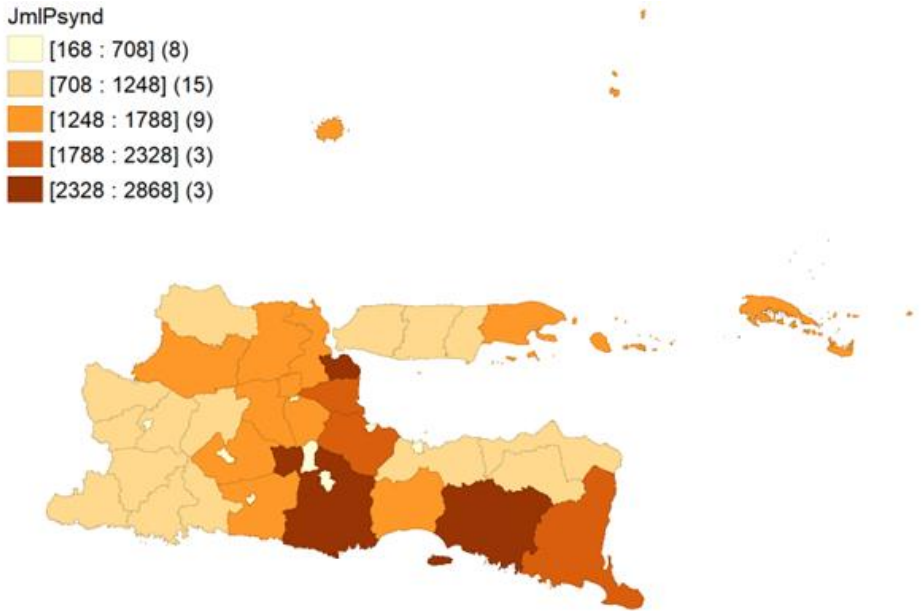

Figure 3. Map of the Distribution of the Number of Posyandu in East Java Province

Based on the distribution map in figure 3, it was found that the highest number of posyandu was in Surabaya City (2,680 posyandu), Jember Regency (2,824 posyandu) and Malang Regency (2,868 posyandu) and the lowest number of posyandu were Malang City (650 posyandu), Kediri City (346 posyandu), Pasuruan City (305 posyandu), Madiun City (270 posyandu), Probolinggo City (219 posyandu), Batu City (184 posyandu), Mojokerto City (170 posyandu), and Blitar City (168 posyandu).

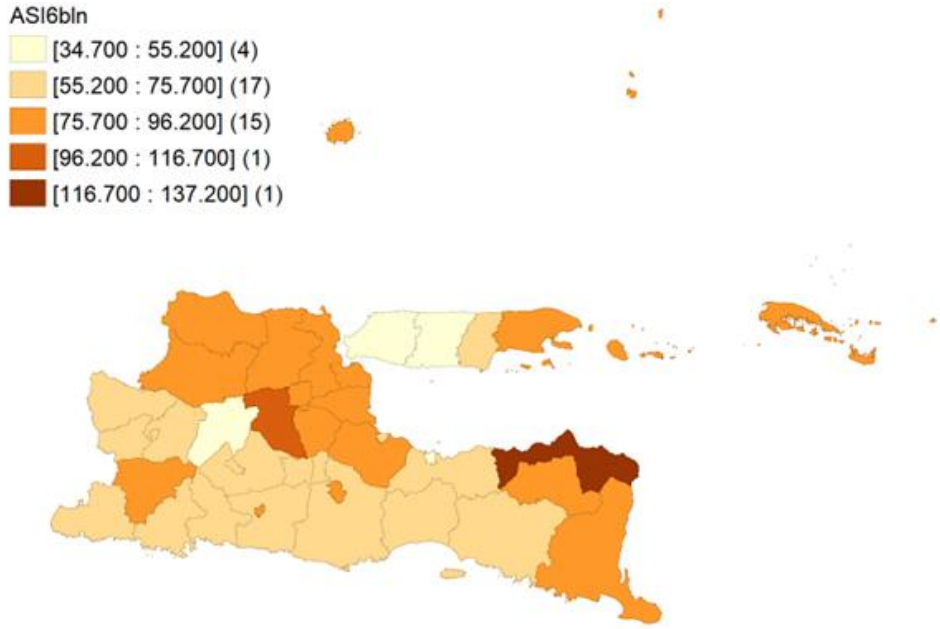

Figure 4. Distribution Map of Exclusive Breastfeeding Percentages for Infants < 6 Months in East Java Province

Based on the distribution map in figure 4, it was found that the highest percentage of exclusive breastfeeding for 6-month-< infants was Situbondo Regency (137.2%) and the lowest percentage of exclusive breastfeeding for 6-month-< infants was Bangkalan Regency (49.4%), Nganjuk Regency (41.1%), Sampang Regency (40.5%), and Probolinggo City (34.7%).

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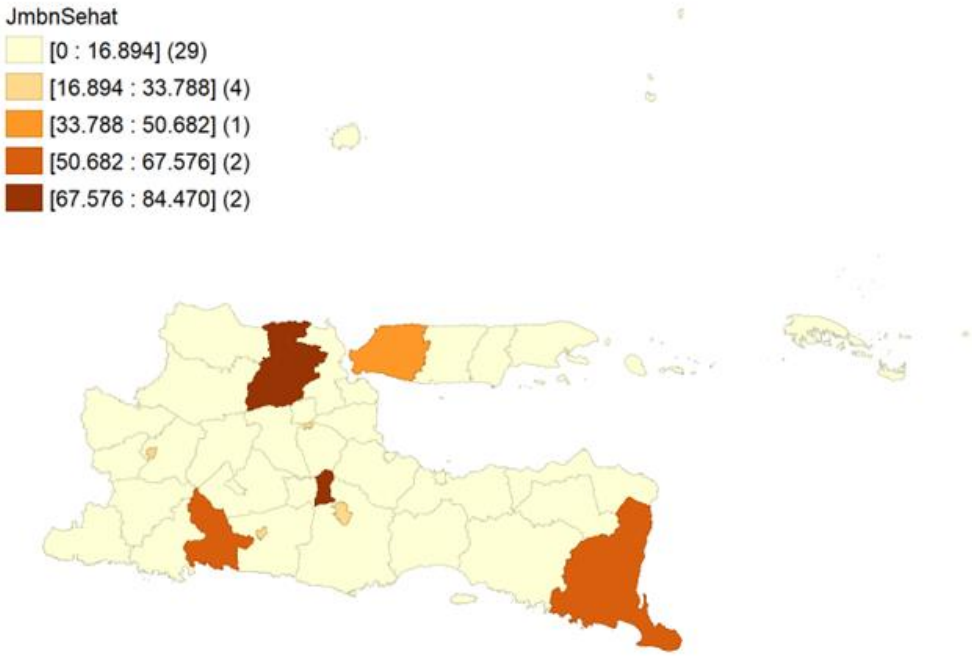

Figure 5. Map of the Distribution of Percentage of Households with Access to Healthy Latrines in East Java Province

Based on the distribution map in figure 5, it shows that there are still many families who do not have access to healthy latrines. The percentage of households with the highest access to healthy latrines is Lamongan Regency (76.19%) and Batu City (84.47%).

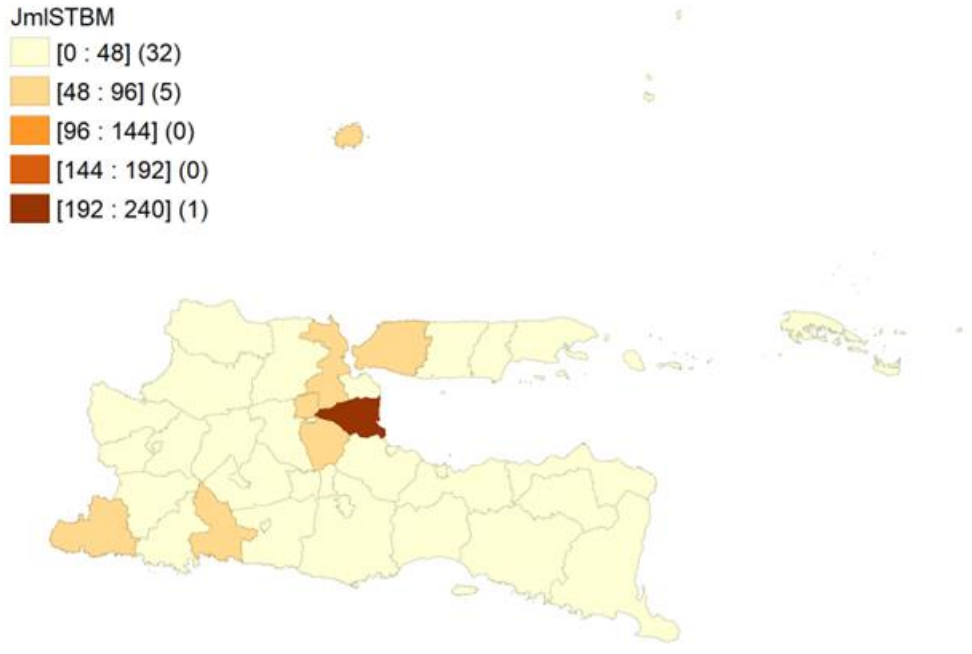

Figure 6. Map of the Distribution of the Number of Villages/Villages with 5 STBM Pillars in East Java Province

Based on the distribution map in figure 6, it shows that there are still many villages/sub-districts that have not implemented the 5 pillars of STBM. The number of villages/sub-districts with the 5 STBM pillars is the highest, namely Sidoarjo Regency (240 villages/sub-districts).

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REGRESSION
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SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set            :  stunting jatim 2023
Dependent Variable  :    Stunting  Number of Observations:   38
Mean dependent var  :     17.7526  Number of Variables   :    6
S.D. dependent var  :     7.00856  Degrees of Freedom    :   32

R-squared           :    0.300999  F-statistic           :    2.75592
Adjusted R-squared  :    0.191780  Prob(F-statistic)     :  0.0351861
Sum squared residual:     1304.72  Log likelihood        :   -121.107
Sigma-square        :     40.7726  Akaike info criterion :    254.213
S.E. of regression  :     6.38535  Schwarz criterion     :    264.039
Sigma-square ML     :     34.3348
S.E of regression ML:     5.85959

------------------------------------------------------------------------------
       Variable      Coefficient      Std.Error    t-Statistic   Probability
------------------------------------------------------------------------------
          CONSTANT       32.1498        4.76794        6.74291     0.00000
        KpdtnPddk  -0.000798375    0.000467694       -1.70704     0.09750
         JmlPsynd  -0.000117593     0.00158459     -0.0742102     0.94130
          ASI6bln     -0.156541      0.0589739       -2.65441     0.01227
        JmbnSehat    -0.0151312      0.0493082       -0.30687     0.76093
         JmlSTBM    -0.0432039      0.0250426       -1.72522     0.09414
------------------------------------------------------------------------------

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER   11.935517
TEST ON NORMALITY OF ERRORS
TEST                   DF           VALUE             PROB
Jarque-Bera             2             0.5479          0.76035

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                   DF           VALUE             PROB
Breusch-Pagan test      5             3.4079          0.63737
Koenker-Bassett test    5             3.4525          0.63059
================================ END OF REPORT =================================
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Figure 7. Multiple Linear Regression Analysis Results

The results of the analysis of this study are shown in figure 7, several tests have been carried out to find out whether the analyzed data has met the assumptions. The results of the normality test in this study showed a value of p=0.76035 (p>0.05), which means that the data was normally distributed. The multicollinearity test showed a condition number value of 11.935517 (value ≤30), which means that it has met the assumption of the absence of multicollinearity. The heterogeneity test with the Breusch-Pagan test, obtained a value of p=0.63737 (p>0.05), which shows that there is no heteroscedasticity, the data has met the assumption of homoscedasticity.

The results of further testing showed that the p-value of F-statistic was 0.0351861 (p<0.05), which means that overall the regression model was significant, there was at least one independent variable in the model that had a significant influence on the bound variable. The variable of the percentage of exclusive breastfeeding in infants < 6 months (p=0.01227) which had a negative coefficient value and p<0.05, showed that the percentage of exclusive breastfeeding in infants < 6 months increased significantly in reducing the prevalence of stunting. In contrast, the variables of population density (p=0.09750), the number of posyandu (p=0.94130), the percentage of households with access to healthy latrines (p=0.76093), and the number of villages/sub-districts with 5 STBM pillars (p=0.9414) have negative coefficient values and p>0.05, which means that the increase in these variables does not have a significant effect on reducing the prevalence of stunting.

The Relationship between Population Density and Stunting Prevalence in East Java Province

In 2023, the population density in the East Java Province area will increase from 2022 (855 people/km2) to as many as 867 people/km2. The East Java Province area does not have many districts/cities that have a high population density. Areas with high population density, make competition for resources such as clean water and nutritious food increase, as well as often inadequate sanitation facilities, which can increase the risk of spreading infectious diseases such as diarrhea. This limitation makes children not get enough nutrition, so it can cause stunting (Kemenkes RI, 2022; Sari, 2023)

In this study, population density did not have a significant effect on reducing the prevalence of stunting. This, in line with research conducted by Tanjung et al. (2024) in Silahisabungan District, obtained the result that no relationship was found between population density and stunting incidence (Tanjung et al., 2024). Population density often affects the quality of services at Posyandu. Health cadres may have difficulty giving enough attention to each child due to the high number of visits. Studies show that effective stunting prevention programs in high-density areas can fail if there is a lack of medical equipment and cadre skills to measure (Kementerian Koordinator Bidang Pembangunan Manusia dan Kebudayaan, 2023; Sekretariat Wakil Presiden Republik Indonesia, 2023).

The Relationship between the Number of Posyandu and the Prevalence of Stunting in East Java Province

Posyandu serves as an ideal platform for optimizing the first 1,000 days of life to combat stunting. This community-driven healthcare initiative facilitates access to medical services for mothers, infants, and toddlers, allowing them to track health progress effectively. Posyandu also offers programs providing supplementary food and vitamins to pregnant women and young children to improve their nutritional status (Hamdy et al., 2023; Mursyidah, 2024). Monthly growth monitoring, recorded on the KMS curve, enables early detection of growth issues in infants and toddlers, helping to prevent stunting or long-term growth problems (Welly et al., 2023).

In this study, however, the number of posyandu facilities did not significantly impact the reduction of stunting prevalence. This finding contrasts with research by Welly et al. (2023), which found a significant correlation between Posyandu attendance and stunting rates in toddlers within the Kereng Pangi Health Center's jurisdiction (Welly et al., 2023).

Another study revealed that there is a possibility that the level of population density can affect accessibility to Posyandu. Factors such as distance and congestion can hinder public access in very congested areas, even though there are many Posyandu. This means that the rate of visits by toddlers to the Posyandu is low, which is important to monitor health and prevent stunting (Permatasari & Eprilianto, 2023; Shafira et al., 2024).

The Relationship Between Exclusive Breastfeeding Rates in Infants Under 6 Months and Stunting Prevalence in East Java Province

Exclusive breastfeeding provides infants with optimal nutrients, including essential vitamins, proteins, fats, and antibodies that help combat infections. Babies exclusively breastfed are less susceptible to infections compared to those who are not. One contributing factor to stunting in children under five is the lack of exclusive breastfeeding, which affects their long-term development. Proper breastfeeding helps maintain a child's nutritional balance, supporting normal growth (Mufidah & Basuki, 2023; Dewi et al., 2022).

In this study, a higher rate of exclusive breastfeeding in infants under 6 months was significantly associated with a reduction in stunting prevalence. This aligns with findings by Sumardiyono (2020) at the "X" Health Center in Banyuanyar Village, Surakarta, which

indicated that exclusive breastfeeding history influences stunting outcomes (Sumardiyono & Kedokteran, 2020).

Socioeconomic factors play an important role in determining the mother's ability to provide exclusive breastfeeding. Research shows that mothers with low family incomes are more likely to breastfeed exclusively because they cannot afford to buy expensive complementary foods or formula. Research conducted by Nurfatimah et al. (2022) found that mothers with high family incomes often switch to complementary foods (MP-ASI) and formula milk more quickly, but this leads to a decrease in the success of exclusive breastfeeding (Nurfatimah et al., 2022).

Research conducted by Bauty (2024) shows that mothers' knowledge and attitudes about breastfeeding are closely related to their level of education. Mothers with a higher level of education usually understand the benefits of exclusive breastfeeding and the correct way to breastfeed. Higher levels of education also contribute positively to the mother's decision to breastfeed exclusively (Bauty, 2024).

The practice of complementary breastfeeding (MPASI) has an important role in supporting exclusive breastfeeding and preventing stunting in children. Meeting children's nutritional needs with timely complementary foods is very important. Studies show that supplementation before the age of six months or after six months increases the risk of stunting. A study conducted by Sangadji (2024) found that most stunted toddlers (87%) received inappropriate complementary foods, which contributed to an increase in stunting rates (Sangadji, 2024).

The Relationship Between Family Access to Healthy Latrines and Stunting Prevalence in East Java Province

Stunting is also linked to access to family latrines. Pathogenic bacteria can spread through inadequate sanitation, such as open defecation, leading to infections like diarrhea and other intestinal issues that impact family health and child growth. Without access to clean, safe toilets, children are more vulnerable to diseases that can lead to stunting (Arring & Winarti, 2024).

In this study, however, family access to healthy latrines did not significantly affect stunting prevalence. This finding is consistent with research by Tanjung et al. (2024) in Silahisabungan District, Dairi Regency, which also reported no significant relationship between family latrines and stunting rates (Tanjung et al., 2024). Access to sanitation and the prevalence of stunting are significantly affected by poverty. Studies conducted in East Java show that the higher the poverty rate, the lower the community's access to proper sanitation, which contributes to an increase in stunting rates. This shows that improving the economic condition of the community can improve access to sanitation and in turn reduce stunting (Dewi et al., 2024).

The Relationship Between the Number of Villages/Sub-districts Implementing the 5 STBM Pillars and Stunting Prevalence in East Java Province

The 5 pillars of STBM are: (1) Stop Open Defecation (SBS); (2) Wash your hands with pillar soap; (3) Drinking Water and Household Food Treatment (PAMMRT); (4) Household Waste Management (PSRT); (5) Household Domestic Wastewater Management (PALDRT) (Kementerian Kesehatan RI, n.d.). The STBM program aims to foster sanitary, health-conscious behaviors within communities to achieve better public health standards. This initiative promotes community-driven behavior change to reduce environment-based diseases, such as diarrhea, respiratory infections, malnutrition, and more, thereby contributing to efforts to decrease stunting prevalence (Sari et al., 2023).

In this study, however, the number of villages/sub-districts implementing the 5 STBM pillars did not significantly impact stunting prevalence. This finding contradicts research by Sari et al. (2023) in Surabaya, which demonstrated that sanitation standards under STBM are correlated with reduced malnutrition and stunting among toddlers. Another study conducted by (Ahsana,

2021), examining the relationship between each STBM pillar to stunting cases, found that the first pillar had a significant relationship with stunting incidence, the second pillar did not show a significant relationship with stunting, the third pillar had a significant relationship with stunting incidence, the fourth pillar also showed a significant relationship with stunting, and the fifth pillar did not show a significant relationship with the incidence stunting.

Conclusion

Based on the mapping results, the highest prevalence of stunting in East Java Province in 2023 is found in Jember Regency, Lumajang Regency, Probolinggo Regency, and Probolinggo City. The most significant factor in reducing the prevalence of stunting is the percentage of exclusive breastfeeding in infants < 6 months. Other variables such as population density, number of posyandu, percentage of households with access to healthy latrines, and the number of villages/sub-districts with 5 pillars of STBM did not have a significant influence.

The results of this study can be used to develop a more effective intervention program in reducing the prevalence of stunting, focusing on exclusive breastfeeding in the first 1,000 days of life (HPK). Further research is needed by considering other variables that may affect the prevalence of stunting, such as maternal nutritional status, access to nutritious food, history of infectious diseases, and economic status.

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