

Case Study in the COVID-19 Pandemic: Stunting, Low Birth Weight, Maternal Mortality and Infant Mortality in Semarang, Central Java-Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Background and Objective: Stunting, low birth weight, maternal death, and child mortality have all become public health issues in recent years, particularly in Semarang, Indonesia. Simultaneously, the COVID-19 pandemic is spreading. Between the years 2019 and 2021.

Methods: The Semarang City Health Service's secondary data analysis strategy was combined with a quantitative descriptive research methodology in this study. To evaluate numerical patterns in stunting, low birth weight, maternal death, and infant mortality in the data, simple regression were utilized.

Results: According to the findings, the trend of stunting (modeling results $y = 35,236x + 361.77$) and maternal mortality (modeling results $0.0218x + 1.2921$) increased between 2019 and 2021, whereas the trend of low birth weight (modeling results $y = -0.5425x + 60.008$) and child mortality (modeling results $y = -0.0028x + 2.202$) decreased. The number of low birth weight has the lowest trend value, while the stunting rate has the greatest.

Conclusion: Stunting rates increased, the low birth weight dropped, maternal mortality increased, and child mortality decreased in Semarang. The conditions of the Covid-19 epidemic have at least influenced this condition.

Keywords: *Stunting; low birth weight; maternal mortality; infant mortality; COVID-19 pandemic.*

1. INTRODUCTION

Malnutrition begins in the womb and continues throughout childhood, affecting brain development and cognitive capacity. This is a risk for future stunting [1] Indicator of stunting is height-for-age ≤ -2 SD of the WHO Child growth standards median and indicator wasting weight-for-height ≤ -2 SD of the WHO Child growth standards median. The percentage of children that are short for their age (stunting) indicates the long-term effects of starvation and illness, which begin before birth. As a result, this metric can be taken as a sign of poor environmental conditions or long-term constraints on a child's ability to grow. The percentage of children that are underweight for their age (underweight) could indicate thinness (low weight for height), acute weight loss, stunting, or both [2].

More than half of stunted children (56%) live in Asia, and more than a third (37%) live in Africa, according to the United Nations Children's Emergency Fund (UNICEF) [3]. After India, China, Nigeria, and Pakistan, Indonesia has the fifth greatest prevalence of stunting. Stunting affects around 38% of children under the age of five in South Asia [4] According to the WHO, if the prevalence of stunting in children under the age of five reaches 20% or above, it becomes a public health issue. As a result, Indonesia's percentage of short toddlers remains high, indicating that this is a public health issue that must be addressed [5]

Stunting in children is a severe issue since it is linked to increased morbidity and mortality, future obesity and noncommunicable diseases, short adults, poor cognitive development, and reduced productivity and income. Malnutrition is responsible for around 10.5 million child deaths per year. In developing nations, 98 percent of these deaths are reported. Stunting can be caused by a variety of circumstances, including low birth weight. If a baby's birth weight is less than 2,500 grams, he or she is at risk of mortality, stunted infant growth, and even being short if not handled properly [6]. When compared to developed countries, infants with low birth weight (LBW) are more likely to undergo intrauterine development retardation due to poor maternal nutrition and higher infection rates [7]. Maternal and newborn mortality are two separate yet connected phenomena. The maternal mortality rate and infant mortality rate are used to determine and measure the success of healthcare implementation. According to 2012

Indonesian Demographic and Health Survey (IDHS), the infant mortality rate (IMR) in Indonesia was 32 per 1000 live births [8]. The 2012 survey's infant death rate was lower than the 2007 survey's figure of 35 per 1000 live births. In the last five years, infant mortality has decreased. This result, however, falls well short of the 2015 Millennium Development Goals (MDGs) goal of reducing infant mortality to 23 per 1000 live births [9]. Maternal death occurs when a woman dies while pregnant or up to 42 days after giving birth, regardless of the length or location of the pregnancy, from any cause connected to pregnancy complications or care [10].

Based on the health problems mentioned above, a projection is needed to identify the number of cases spreading in various places, one of which is Semarang, to assist the Semarang City Government in dealing with these problems. The government can implement various policy plans and preparations to deal with a surge or decrease in cases of health problems such as stunting, LBW, and maternal-infant mortality in the city of Semarang with predictions especially for several cases of health problems such as stunting, low birth weight, and maternal-infant mortality. Case histories of stunting, low birth weight, maternal mortality, and infant mortality need appropriate treatment [11]. After that, the Semarang city government developed a strategy to overcome the increase in stunting cases. Therefore, in 2021-2022 a research will be carried out in Semarang to get a general picture so that it can predict the incidence of stunting, low birth weight, and maternal-infant mortality in the future. The results of the research can be used as a baseline by the Semarang city government in establishing a policy regarding the handling of stunting, low birth weight, and maternal-infant mortality.

2. METHODS

This study employed a quantitative descriptive research method with secondary data analysis from the Semarang City Health Office on cases of stunting, low birth weight, and maternal-infant mortality in Semarang from 2019 to 2021. The basic formula for predicting linear regression is used in this study, and secondary data in the form of information is retrieved or collected from previously published sources [12].

The following is a simple linear regression formula for determining predictions:

$$Y_n = a \pm b \cdot x$$

- Y_n = the number of predicted results, In a certain period,
- a = yearly average number of items $= \frac{\sum Y}{n}$
- b = yearly trend of increase/decrease $= \frac{\sum XY / \sum X^2}$
- x = year prediction order

3. RESULTS AND DISCUSSION

Based on secondary data from the Semarang City Health Office, the number of stunting, low birth weight, and maternal-infant mortality in the city of Semarang from 2019 to 2021 are as follows:

3.1 Stunting Case Data

Table 1. The number of stunted children in Semarang from 2019 to 2021

Month	Th2019	Th2020	Th2021
January	1.165	1.181	1.467
February	472	1.229	1.794
March	476	1.351	1.566
April	530	210	1.611
May	505	203	1.982
June	517	191	2.187
July	532	216	2.392
August	440	312	1.489
Sep	476	271	1.525
October	1.075	436	1.560
November	1.460	445	1.595
December	1.504	496	1.630
Average	763	545	1.733

Based on Table 1, the month with the highest number of stunting is December (1504 persons) in 2019, March (1381 persons) in 2020, and July in 2021(2.392 persons).

The projection of the number of stunting in the month with the highest trend is shown in Fig 1.

Graph 1 displays the pattern of the highest number of stunting in July compared to other months using the equation model $y = 930 x - 813.33$.

Based on data from 2019 to 2021, Fig. 2 illustrates the highest trend in the number of stunted children as follows.

Stunting numbers peaked in 2019 ($y = 57,217x + 390.76$), then started to drop in 2020 ($-71.115x + 1007.3$) and 2021 ($y = -6,0978x + 1772.8$).

With the equation $y = 485.25x + 43.139$, the trend in the number of stunting from 2019 to 2021 shows an increase.

Childhood stunting is the best overall indication of children's well-being and the most accurate reflection of socioeconomic inequality. The city of Semarang has a relatively high number of stunting, with the number of sub-districts that are the main points of stunting cases reaching 25 districts [13]. Local governments are concerned about the frequency of stunting in Semarang, which has prompted the construction of an integrated stunting reduction intervention.

The rising stunting rate is due to the reduction in socioeconomic conditions during the pandemic. The pandemic phase in 2020 will increase global poverty levels, have an impact on socioeconomic conditions, and, of course, have a slew of bad consequences, including newborn birth delays and an increase in stunting instances around the world [14]. This demonstrates that the COVID-19 pandemic affects stunting, particularly in low- and middle-income nations. [15]. If this condition persists, the economics of the community will deteriorate, leading to an increase in stunting instances [16]. The city government's policies have changed since the issuance of the Mayor of Semarang's Decree No. 443/227 of 2020 concerning the determination of the emergency response status of the corona virus outbreak (Covid-19) in the city of Semarang in March 2020, with many hospitals and health centers focusing more on Covid-19 patients. Hospitals and healthcare facilities are focusing more on serving Covid 19 patients during the pandemic. On the other hand, the Semarang city government continues to make efforts to reduce the number of undernourished people (stunting and wasting). To combat stunting, all stakeholders work together across sectors and initiatives [17]. As a result of this situation, the Semarang city government's stunting reduction program is disrupted, allowing for a decrease in the number of stunting cases in the Semarang city region.

3.1.1 Data on the number of babies born with a low birth weight

Low birth weight (LBW) is a public health issue in the city of Semarang that requires special attention. [18]. Table 2 shows data on cases of newborns born with LBW in Semarang from 2019 to 2021.

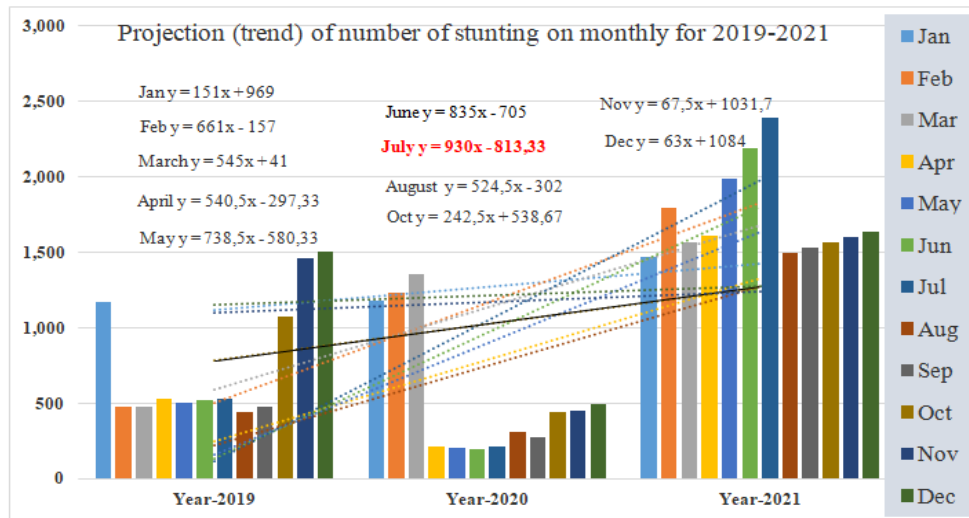


Fig 1. Projected stunting data for 2019, 2020, and 2021 based on monthly data

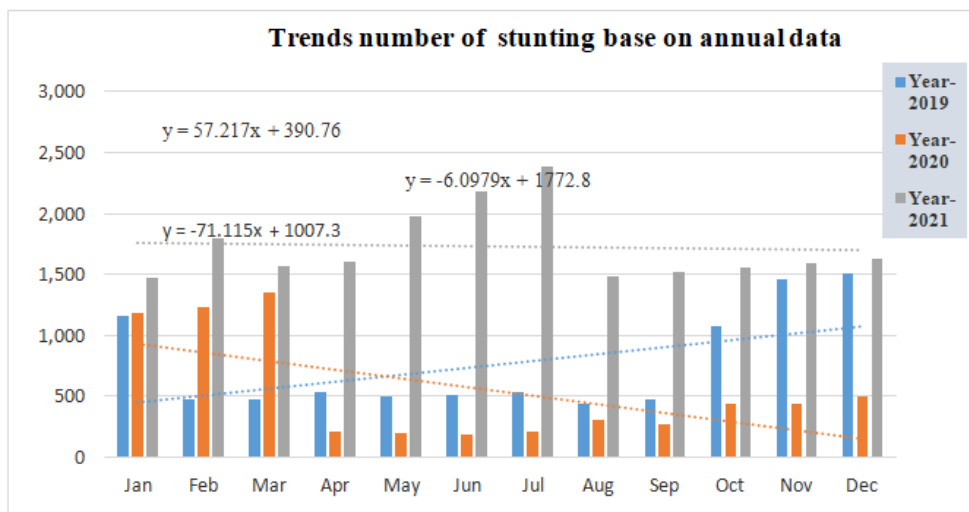


Fig. 2. Trend number of stunted children in 2019, 2020, and 2021

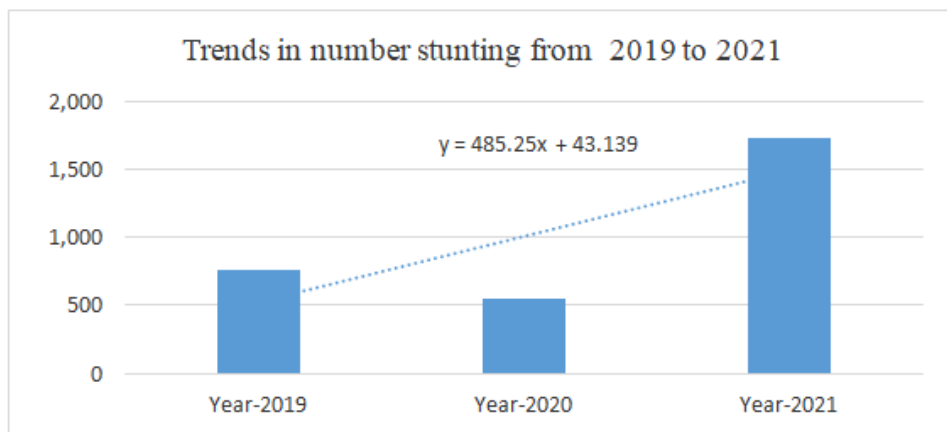


Fig. 3. Trends in the number of stunting from 2019 to 2021

Table 2. Data on the number of babies born with a low birth weight for the 2019-2021 period

Month	th2019	th2020	th2021
January	67	28	27
February	56	53	40
March	55	64	26
April	70	56	59
May	72	54	52
June	61	74	39
July	44	50	37
August	57	77	43
Sep	45	82	42
October	38	66	42
November	40	28	41
December	35	39	40
Average	53	56	41

According to the statistics in Table 2, the incidence of low birth weight (LBW) in children occurred in May in 2019 (72 persons), September in 2020 (82 persons), and April in 2021 (59 persons).

Based on the year of occurrence, the following low birth weight (LBW) case data is expected for 2019, 2020, and 2021: Monthly data on the number of low birth weight (LBW) in children are projected for 2019, 2020, and 2021.

Fig. 4 depicts the largest trend in the number of low birth weight (LBW) in January using the equation model $y = -20x + 80,667$, whereas Fig. 5 depicts the largest trend in the number of low birth weight (LBW) using the highest yearly data, as follow.

The number of low birth weights decreased in 2019 ($y = -2.8042x + 71.561$), but began to increase in 2020 ($0.2972x + 52.985$) and 2021 ($y = 0.5245x + 37.258$).

Fig. 6 shows the projection (trend) of the number of low birth weight data between 2019 and 2021.

With the equation $y = 6.3333x + 62.639$, the trend of the incidence of LBW from 2019 to 2021 shows a decrease.

Low birth weight is a potential risk factor for COVID19, although data on the occurrence of low birth weight in the city of Semarang from 2019 to 2020 shows a decrease, albeit remaining in a high category (average 50 incidents per year) [19]. The city government of Semarang is attempting to reduce the incidence of low birth weight babies (LBW) through a variety of health education programs, supervision and monitoring,

infant hypothermia prevention, no-cost therapy, measuring the nutritional status of pregnant women, performing calculations, and preparing health-related steps and These efforts are proposed to be made by the mother herself, or by health-care cadres in health-care facilities [20].

The COVID-19 pandemic has had an impact on the incidence of low birth weight over the world (LBW). Despite a decrease in the number of low birth weight (LBW) cases, the Semarang City Government must exercise caution because Covid-19 cases have not abated, and LBW appears to be a separate risk factor for severe COVID-19, potentially increasing risk stratification. LBW babies are at a higher risk of developing a variety of health issues [21]. Several measures can be made to prevent and control low birth weight (LBW), including giving proper health education about low birth weight (LBW) to pregnant women [22]. If efforts to prevent and control low birth weight (LBW) are properly carried out, success in increasing baby weight will be realized; the mother's level of knowledge in managing the distance between pregnancies and knowing unsafe ages to undergo pregnancy and childbirth, as well as providing nutrition beginning during pregnancy and childbirth, will be realized. Maintain the health of yourself and the kid in the womb until it reaches the age of two years, and pay close attention to the cleanliness of the environment [23]. Health education, supervision, and monitoring, avoidance of hypothermia in infants, free therapy that can be done, testing the nutritional status of pregnant women, and calculating and preparing steps in health are all part of these prevention and control initiatives (antenatal care) [24]. The low birth weight (LBW) is a public health issue that requires special attention in several countries, particularly in emerging or low-income countries. The low birth weight (LBW) cases in children are similar to the consequences of the global COVID-19 epidemic (infants). The financial situation of parents, diminishing parental income, understanding of child (infant) health, and lack of regular baby check-ups at health service centers or hospitals all play a role in the occurrence of low birth weight (LBW).

3.1.2 Data on the number of deaths among mothers and children (infants)

Maternal and child mortality is a multidimensional issue that necessitates a complete solution and

strategy based on a collaborative partnership approach. This is a critical issue that must be addressed immediately because it has a significant impact on future generations' quality of life as well as maternal health. The Maternal Mortality Rate is a measure of how well the health sector has progressed. In response to this problem, the Semarang City Health Office, through the Semarang City Regional Regulation Number 2 of 2015 concerning maternal and child safety, seeks to reduce maternal mortality by involving various stakeholders, including

developing collaborative integrative programs based on partnerships involving multiple stakeholders. Promotively, preventively, and curatively, the health service innovation program is a type of solution and action for mother and child health concerns. [22] Maternal and Child Health Surveillance officers will visit clients' homes to provide support (homecare) to pregnant women, postpartum moms, and babies to prevent high-risk pregnancies. In the city of Semarang, it is intended that this approach can reduce maternal and child mortality [25].

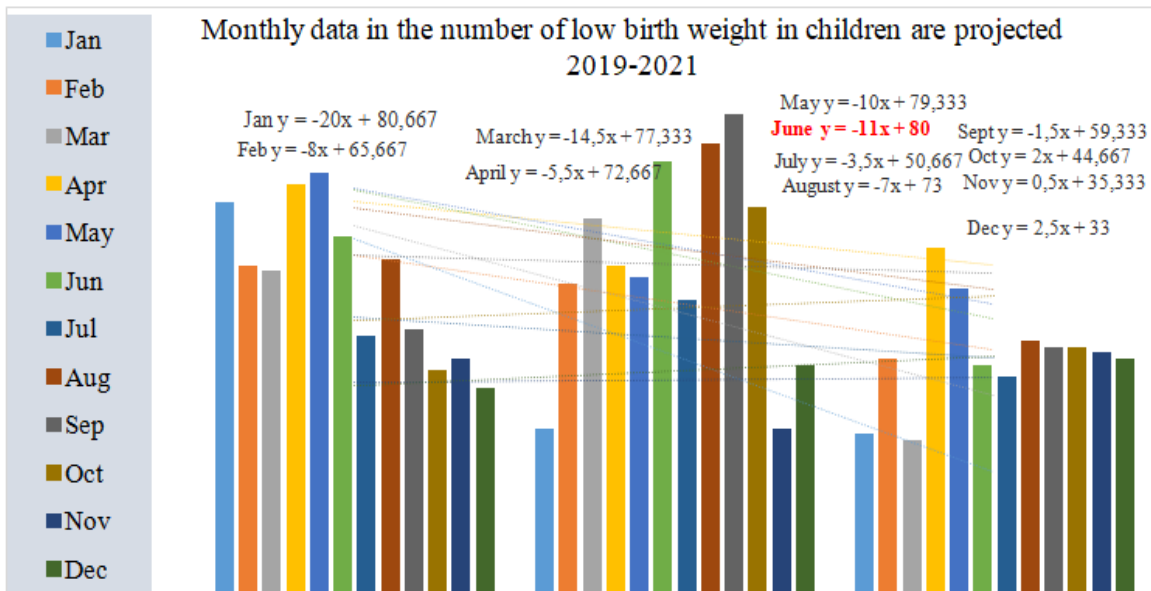


Fig. 4. Monthly data on the number of low birth weight (LBW) in children are projected for 2019, 2020, and 2021

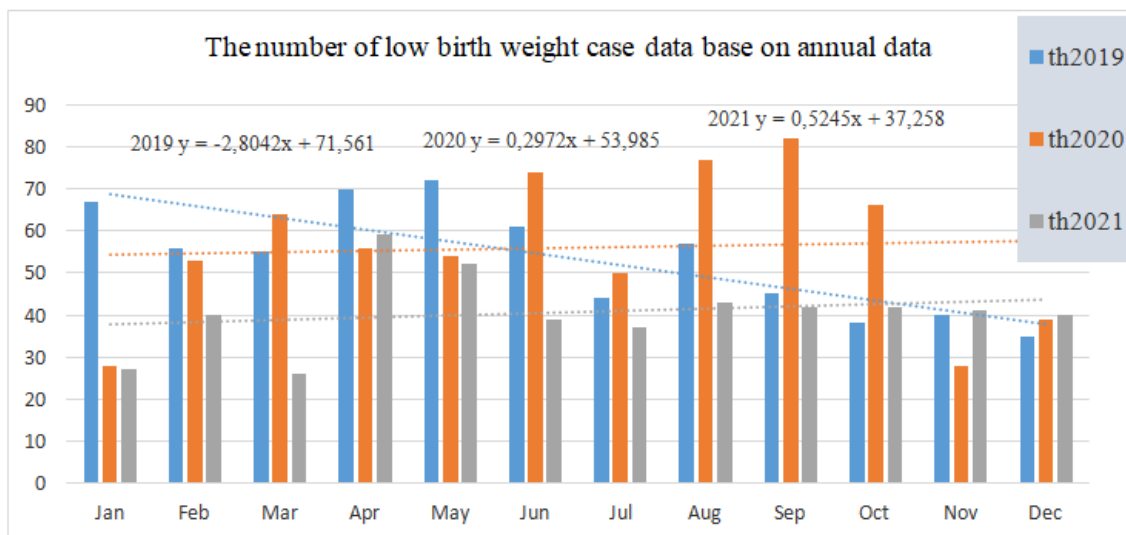


Fig. 5. The number of LBW is projected for 2019, 2020, and 2021 based on annual data

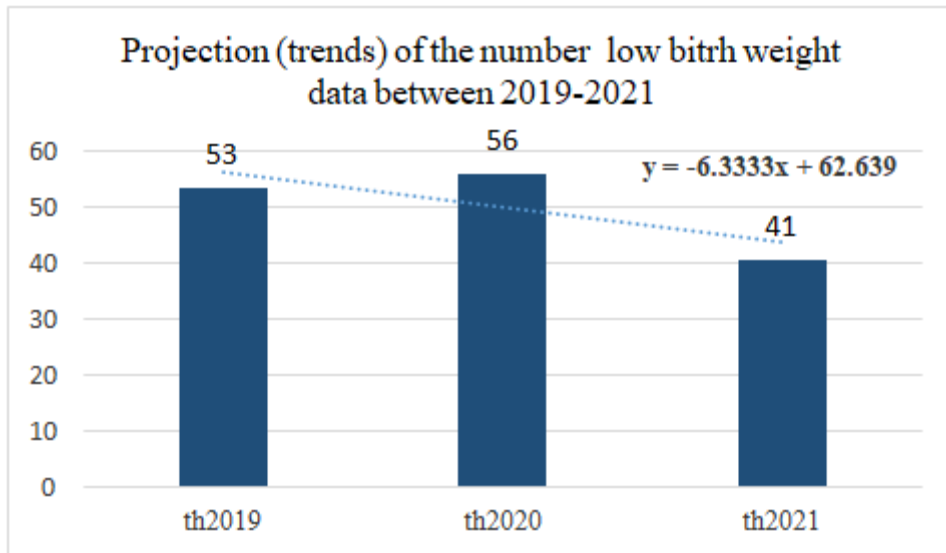


Fig. 6. Trends in combined low birth weight case data between 2019 and 2021

3.1.3 Data on the number of maternal deaths in Semarang

Table 3 shows the following data on maternal mortality in the city of Semarang from 2019 to 2021:

Table 3. Data on maternal mortality cases in Semarang City for the 2019-2021 period

Month	th2019	th2020	th2021
January	4	1	2
February	2	1	1
March	1	2	1
April	2	1	1
May	1	0	1
June	3	4	8
July	0	1	2
August	0	1	2
Sep	2	2	2
October	2	1	2
November	0	1	2
December	1	2	2
Average	1,5	1,4	2,2

The months with the highest maternal mortality rates, according to Table 1, are January 2019 (4 persons), June 2020, and 2021, each group has eight people.

Based on monthly data, Fig. 6 depicts maternal mortality case data projections for 2019, 2020, and 2021, as follow.

Fig. 7 shows that the monthly data-based pattern of increasing maternal mortality peaks in June (y

= 2.5 x), while Fig. 8 illustrates that the highest number of maternal deaths will occur in 2021, as follows.

According to Fig. 8, based on annual data, the number of maternal fatalities increased from 2019 to 2021, with the biggest growth in 2021 (y = 0.0629x+1, 7576), then in 2020 (y=0.0315x + 1.2121), and the lowest trend in 2019 (y = - 0.1748+2.6364). From 20219 to 2021, Fig. 9 illustrates the trend in the number of increasing maternal deaths, as follow.

Based on the combined data on the number of mother fatalities from 2-19 to 2021, the number of maternal deaths between 2019 and 2021 shows a positive or growing trend (y=0.3333x+1.0278) (Fig. 8). This shows that the number of maternal deaths during the pandemic may increase. As most hospitals and health institutions are overcrowded with COVID-19 patients, services for pregnant women are being neglected. As a result, there may be incorrect management or delayed delivery in the hospital. This could be related to the concerns of some mothers about having their condition checked in the hospital for fear of contracting or transmitting COVID-19.

The frequency of maternal mortality owing to Covid-19 contributed 20% of the maternal mortality rate in Indonesia during the pandemic, according to national data (Indonesia). In July, 536 pregnant women were reported to have been infected with the coronavirus, a threefold rise over the previous month. Of those, 52

percent, or 278 pregnant women, tested positive for Covid-19 but showed no symptoms [26]. Obstetricians and gynecologists are on high alert since they are at risk of catching the coronavirus as a result of this condition [27]. This pandemic has an influence on all parts of life, including the availability and quality of health care, particularly

maternal and child health services. This service program has become a national priority because it affects maternal and neonatal mortality, which is a national problem [28]. Efforts undertaken during the Covid 19 outbreak were insufficient, resulting in three years of data in Semarang being insufficient.

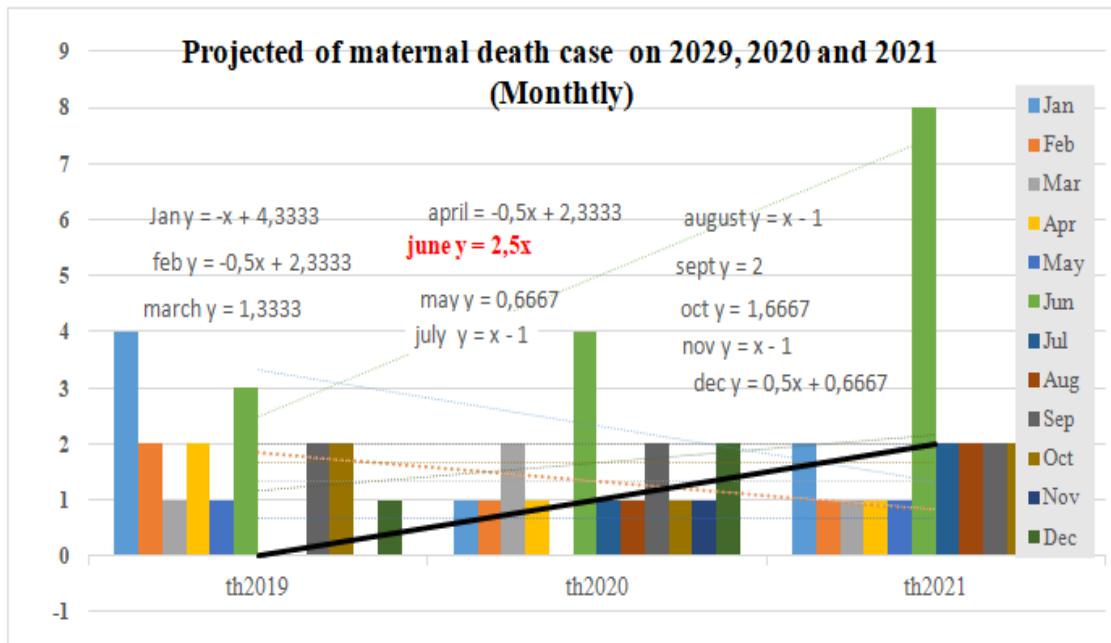


Fig. 7. Projected number of maternal deaths in 2019, 2020, and 2021 based on monthly data

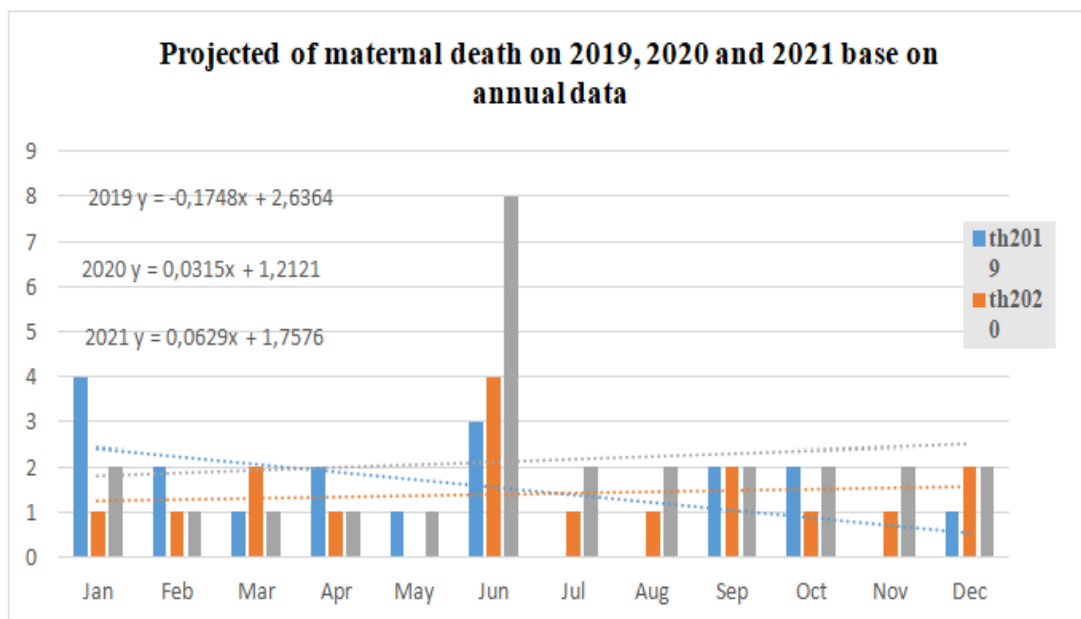


Fig. 8. The number of maternal deaths is projected for 2019, 2020, and 2021 based on annual data

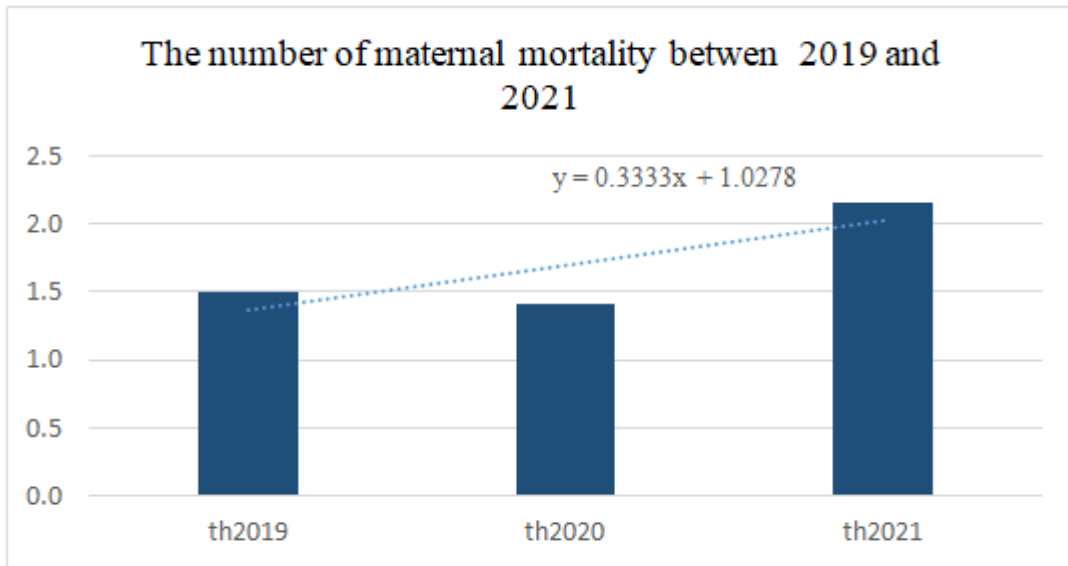


Fig. 9. Trends in combined maternal death case data between 2019 and 2021

3.1.4 Data on the number of child/infant deaths in Semarang from 2019 to 2021

The government's top objective in the 2015-2019 National Preventive Development Plan is the Newborn Mortality Rate, which is a target for the Sustainable Development Goals that must be met by 2030 [29]. The Semarang City Government offers a comprehensive and high-quality service program, which includes integrated antenatal services provided by health workers through health services such as pregnancy, childbirth, postpartum, and family planning counseling, which includes promotive, preventive, curative, and rehabilitative counseling. satisfy every pregnant woman's right to high-quality antenatal care, allowing her to have a healthy pregnancy, give birth safely, and have a healthy baby. The program's adoption has been fairly limited due to the policy of keeping a gap between minimizing the larger risk of getting COVID-19 during the COVID-19 pandemic.

Table 4 shows data on the number of child (infant) deaths in the city of Semarang for the period 2019 to 2021, as follows.

Based on the statistics in Table 4, the largest child mortality cases occurred in August 2019 (18 people), October 2020 (17 people), and July and February 2020 (11 people each).

According to annual statistics on the number of child deaths, the highest occurred in 2019 ($y=$

$0.8846x+6$), next in 2020 ($y=0,3007x+7.3788$), and finally in 2021 ($y= -0.0385x+8.6667$). The data shows that there is a decrease in the number of child deaths from 2019 to 2021.

Table 4. Data on child/infant mortality cases in periode 2019 to 2021

Month	th2019	th2020	th2021
Jan	0	2	10
Feb	12	9	11
Mar	14	9	6
Apr	9	9	9
May	8	11	5
Jun	12	10	6
Jul	9	9	11
Aug	18	10	9
Sept	14	13	9
Oct	15	17	9
Nov	14	13	8
Dec	16	0	8
Avg	12	9	8

Even though there are many factors that influence this and many things have not been studied, it appears that the community has understood and implemented the use of masks, maintaining a safe distance, and washing hands with soap, as well as the incidence of COVID, so that the child mortality rate shows a downward trend in 2019 and 2020. Simultaneously, the Semarang municipal government has begun to implement a well-coordinated and intensive program to reduce child mortality.

Fig. 9 depicts the child (infant) mortality cases for the years 2019, 2020, and 2021, based on annual data, as follow.

Based on data from 2019, 2020, and 2021, Fig. 9 demonstrates that the biggest trend with the linear equation model $y = 5x - 6$ occurred in June.

Base on Fig. 10 data Trends in combined child (infant) mortality case data between 2019 and 2021, there is a decreasing trend with the equation model $y = -1.6667x + 13.67$

Even though the Semarang city government's program was successful in lowering newborn death rates. During this pandemic, it's important to keep an eye on things since an increase in covid 19 transmission, particularly cases caused by virus mutations, is still a potential [30].

A linear regression equation model is a method for predicting an event's quality or quantity. This is because it can be used as a starting point for formulating decisions or policies by estimating several parameters as a summary.

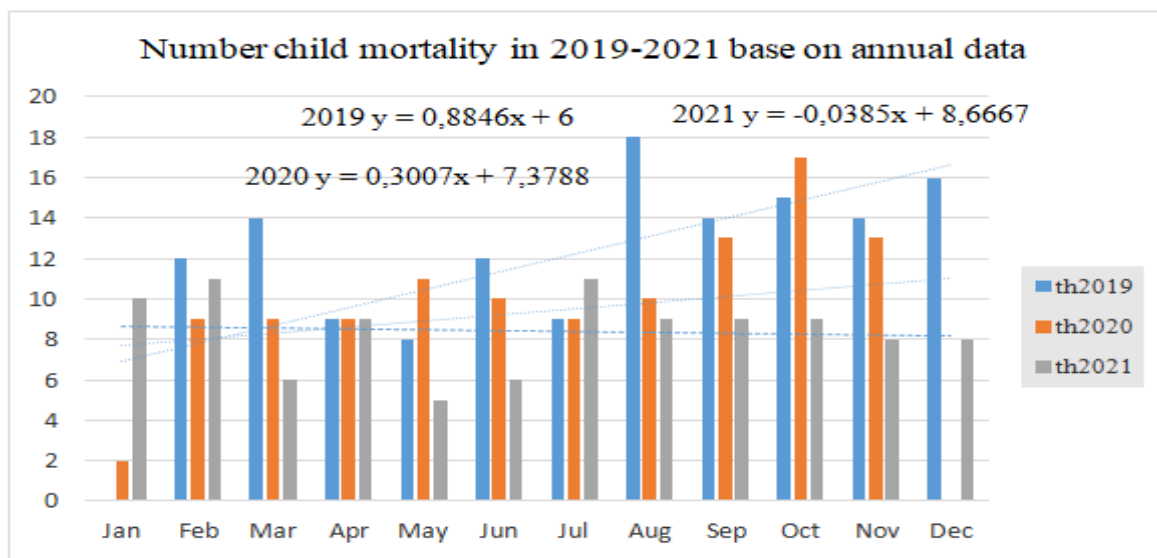


Fig. 10. Number of child (infant) deaths in 2019, 2020, and 2021 based on annual data

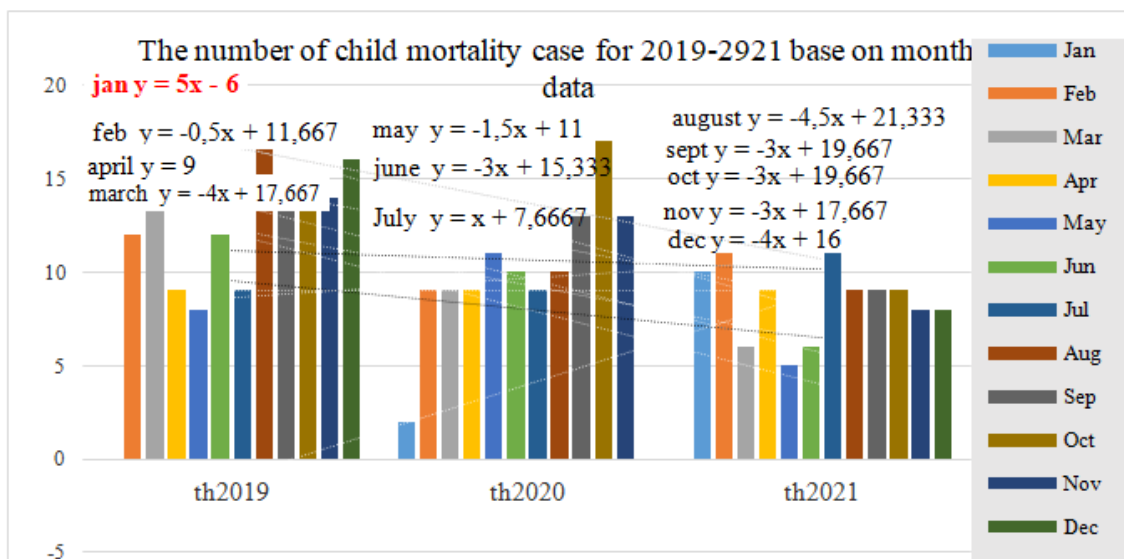


Fig. 11. Child (infant) mortality cases for 2019, 2020, and 2021 base on annual data

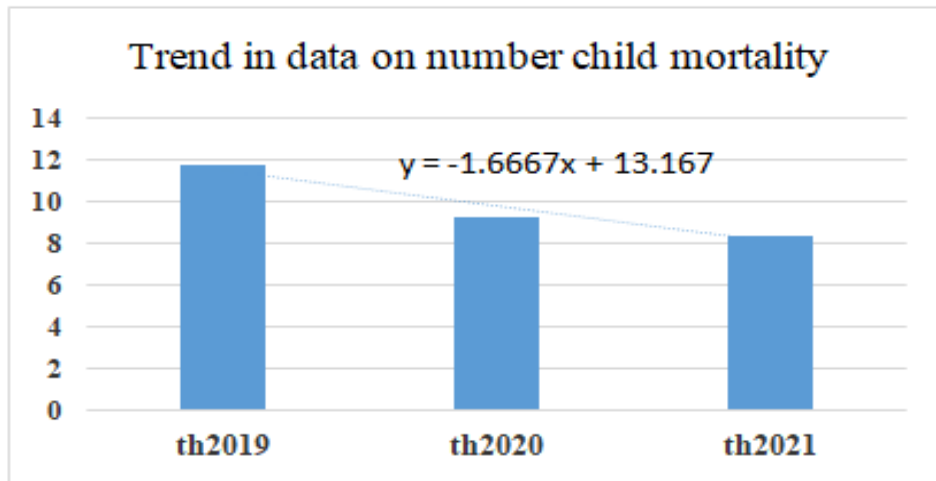


Fig. 12. Trends in the number of child (infant) deaths between 2019 and 2021

4. CONCLUSION

The most stunting occurred in December 2019, with the highest monthly trend occurring in July and the highest annual trend occurring in 2019. In general, the stunting rate has an increasing trend based on data from 2019 to 2021.

The most Low Birth Weight (LBW) occurred in September 2020, with the highest monthly trend occurring in July and the highest annual trend occurring in 2021. In general, the number of LBW in the city of Semarang has a downward trend based on data from 2019 to 2021.

The most maternal mortality rates occurred in June 2020 dan June 2021, with the highest monthly trend occurring in June and the highest annual trend occurring in 2021. In general, the number of maternal mortality in the city of Semarang has a increase trend based on data from 2019 to 2021.

The most child (infant) mortality rates occurred in August 2019, with the highest monthly trend occurring in January and the highest annual trend occurring in 201. In general, the number of child (infant) mortality in the city of Semarang has a decreasing trend based on data from 2019 to 2021.

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

DATA AVAILABILITY

The working papers and accompanying information files contain all necessary information. This research will aid researchers in identifying critical areas related to stunting, low birth weight, maternal mortality, and infant mortality in Semarang, Indonesia.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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