Jurnal Aplikasi Sains Data

Journal homepage: https://jasid.upnjatim.ac.id/index.php/jasid

Statistical Analysis of Infant Malnutrition Cases in North Sumatra Before and After COVID-19 Using the Wilcoxon Test

Serlinda Mareta Putri[1], Desi Daomara Sitanggang[2], Sesillia Agustin[3] , Dwi Arman Prasetya[*4], Tresna Maulana Fahrudin [5]

[1,2,3,4,5] Universitas Pembangunan Nasional "Veteran" Jawa Timur

[*]arman.prasetya.sada@upnjatim.ac.id

ABSTRACT

Child malnutrition remains a very important public health issue in Indonesia. Malnutrition is a condition of deficiency in energy and essential nutrients that can lead to impaired physical growth, mental development, and an increased risk of mortality in children. The prevalence of malnutrition among toddlers in Indonesia is still quite high and shows disparities between regions, especially in provinces with high poverty rates. One province of concern is North Sumatra, which, according to data from the Ministry of Health, has had a significant incidence of malnutrition in the last five years. This condition was exacerbated by the emergence of the COVID-19 pandemic at the end of 2019, which has had a major impact on various sectors of life, including family health and economy. The pandemic caused significant disruptions to primary healthcare systems, including a decrease in posyandu activities, immunizations, and monitoring of children's nutritional status. The decline in household income during the pandemic made it difficult for families to meet their balanced nutritional food needs. A UNICEF study showed an increased risk of acute malnutrition in children during the pandemic, especially in previously vulnerable areas. To measure the impact of the COVID-19 pandemic on the incidence of child malnutrition, a statistical approach that can compare data before and after the pandemic is needed. This study aims to analyze the difference in the incidence of child malnutrition before and after the COVID-19 pandemic in North Sumatra Province using the Wilcoxon test method. Using the Wilcoxon Signed-rank Test statistical method, a comparative analysis was performed between the medians of the data from 2018 and 2023. The results of the study showed that there was a difference between the medians of the two data sets.

Keywords: covid-19, malnourishment, north-Sumatera, Wilcoxon.

I. INTRODUCTION

The issue of child malnutrition remains a critical public health concern in Indonesia. According to [1], malnutrition is a condition of energy and essential nutrient deficiency that can hinder physical growth, mental development, and increase the risk of death in children. Based on [2], the prevalence of malnutrition among toddlers in Indonesia remains high and shows regional disparities, especially

*Corresponding author.
E-mail address:
arman.prasetya.sada@upnjatim.ac.id
doi: 10.33005/jasid.v1i2.16

in provinces with high poverty levels. One province of particular concern is North Sumatra, which, according to data from the Ministry of Health [3], has shown a significant number of malnutrition cases over the past five years.

According to [4], the causes of malnutrition in Indonesia are highly complex and involve various aspects, including improper parenting, low parental education levels, economic limitations, limited access to healthcare services, and inadequate availability and consumption of nutritious food. An analysis by the Central Statistics Agency (BPS) [5] shows that unequal distribution of health and education facilities among districts/cities in North Sumatra contributes to the stark differences in child malnutrition rates across regions.

This situation has been exacerbated by the emergence of the COVID-19 pandemic at the end of 2019, which has had a major impact on various sectors of life, including family health and the economy. According to [6], the pandemic caused significant disruptions to primary healthcare systems, including decreased activity in community health posts, immunization services, and monitoring of children's nutritional status. Based on [7], the decline in household income during the pandemic made it difficult for families to meet their needs for balanced, nutritious food. A study by UNICEF [8] showed an increased risk of acute malnutrition among children during the pandemic, especially in regions that were already vulnerable.

According to \9], North Sumatra Province showed an increasing trend in malnutrition cases during the pandemic, reflecting how the crisis worsened the socio-economic conditions and household food security. Based on a report from the Coordinating Ministry for Human Development and Cultural Affairs (Kemenko PMK) \[10], children from poor families experienced reduced nutrient intake and limited access to healthy food during the pandemic. This indicates that COVID-19 was not only a health crisis but also a nutrition crisis with long-term impacts on the quality of future generations.

To measure the impact of the COVID-19 pandemic on the incidence of child malnutrition, a statistical approach is needed to compare data before and after the pandemic. According to [11], the Wilcoxon test is an appropriate non-parametric statistical method for analyzing differences between two paired data groups, especially when the data are not normally distributed. Based on [12], this method is widely used in public health research because it is flexible and does not require strict normality assumptions. In the context of this study, the Wilcoxon test is used to compare malnutrition data from districts/cities in North Sumatra Province in the pre-pandemic year (2018) and the post-pandemic year (2023).

This study is designed to compare the rates of child malnutrition before and after the COVID-19 pandemic hit North Sumatra Province. Researchers will use the Wilcoxon test method, a statistical tool that helps identify if there is a significant difference between two related data sets. By examining nutritional data collected from local health clinics, schools, or community surveys, the study aims to uncover whether the pandemic has worsened or changed the pattern of child malnutrition in the region. This is especially important because many factors influence child nutrition, including income levels, food availability, health services, and social support systems. The pandemic disrupted many of these elements, leading to concerns about increasing malnutrition rates among children, especially in vulnerable communities. Comparing data from before and after the pandemic will help clarify the impact of these disruptions.

The results of this analysis are expected to provide valuable insights into how COVID-19 has affected children’s health in North Sumatra. It will help identify specific periods and regions where malnutrition increased the most. For example, if the study finds a significant rise in underweight children in rural areas during the pandemic, health authorities can focus their efforts there. The findings will also shed light on whether existing nutrition programs managed to buffer some of the pandemic’s negative effects or if new strategies are needed. This information is crucial for developing focused and effective health policies and nutritional programs that can better support children in times of crisis.

The research aims to support healthcare planners, policymakers, and community leaders with solid evidence. They can use this data to design better intervention plans tailored to the needs of affected children. For instance, local governments could allocate more resources to food aid or health education in areas with high malnutrition rates. Health workers might use the insights to improve screening and treatment programs, ensuring children receive proper nutritional care quickly. Non-governmental organizations can also use the findings to develop community outreach and support networks that help families recover from the adverse effects of the pandemic. These strategies are essential to reversing any negative trends identified by the study and ensuring children

receive proper nutrition moving forward.

Beyond local officials and health workers, this research can serve as a useful reference for other regions experiencing similar challenges. Many areas with high malnutrition rates are struggling to rebuild after COVID-19. Sharing the findings can help inspire and inform broader efforts aimed at nutrition recovery. The data can also reveal important patterns, such as specific age groups or socioeconomic factors most affected by the pandemic. This knowledge can guide future plans to strengthen nutrition systems and prepare for any future health emergencies. Overall, this study aims to produce a clear, factual picture of the pandemic's effects on child health, allowing for more targeted, effective action. It ultimately helps ensure that children's health and nutrition receive better attention and support during challenging times.

II. Materials and Methods

A. Theoretical Framework

According to Ghozali [7], nutritional status is an important indicator in assessing the well-being and quality of life of children. It is heavily influenced by a balanced nutritional intake, the educational level of parents, and the socioeconomic conditions of the surrounding community. The presence of malnutrition in children is not only a concerning health indicator but also reflects the lack of access to nutritious food and adequate healthcare services. According to the WHO [5], malnutrition primarily occurs in young children living in areas with high poverty rates, low food security, and poor environmental sanitation. In the context of Indonesia, data from the Ministry of Health indicates that malnutrition remains a national issue, particularly in regions outside Java, such as North Sumatra, which has a relatively high prevalence of malnutrition compared to other provinces [3].

According to the FAO & WFP report [6], the COVID-19 pandemic has had a significant impact on the socioeconomic aspects of global communities, including in Indonesia. Restrictions on economic activities, reduced household income, and limited physical mobility have resulted in decreased access to nutritious food, especially for families with young children. The pandemic also disrupted food logistics distribution and reduced families' ability to provide quality food. Based on the Coordinating Ministry for Human Development and Cultural Affairs (Kemenko PMK) [4], this situation has indirectly affected children's nutritional status in Indonesia during and after the pandemic.

In this study, a non-parametric statistical approach is used to analyze pre- and post-pandemic data. According to Trihendradi [8], one of the commonly used non-parametric statistical methods in health research is the Wilcoxon Signed Rank Test, as it is suitable for analyzing two paired data groups that do not meet the assumption of normal distribution. The Wilcoxon test is particularly appropriate when researchers aim to examine the difference in effects of a certain event or treatment—such as the COVID-19 pandemic—on related numerical data. Tiurma Sinaga et al. [9] also used the Wilcoxon test in their study to evaluate the impact of nutritional interventions on the nutritional status of elementary school children, and it proved to yield valid analytical results despite the data not being normally distributed.

Furthermore, according to Sabilla Leviana & Yulia Agustina [10], unbalanced eating patterns during the pandemic contributed to the rise in malnutrition cases among elementary school students. This is supported by Anjar Briliannita et al. [11], who demonstrated that providing nutrient-dense foods led to significant changes in children's weight, proving that nutritional factors are highly sensitive to social changes such as a pandemic. Therefore, the use of the Wilcoxon approach is highly relevant in this study as it offers a flexible analytical framework capable of capturing significant changes in nutritional status across two different time periods.

B. Research Methodology

This study employs a quantitative method with a descriptive-comparative approach, aiming to compare the prevalence data of child malnutrition before and after the COVID-19 pandemic in North Sumatra Province. The data used comes from official institutions, namely the Central Statistics

Agency (BPS) and the North Sumatra Provincial Health Office, which provide data on the number of malnourished children in each regency/city for the years 2018 and 2023. The year 2018 is selected to represent the pre-pandemic condition, while 2023 represents the post-pandemic period, allowing for a direct comparison.

According to Firnaliza Rizona [12], secondary data from official agencies is highly important in ensuring the reliability of information, as it has undergone validation processes at the government level. The data is collected in .csv format and processed using a non-parametric statistical analysis approach, namely the Wilcoxon Signed Rank Test, as suggested by Ghozali [7], who stated that this method is highly suitable for analyzing paired data that does not follow a normal distribution, such as social and public health data. This approach is also supported by WHO [5], which emphasizes the importance of periodic nutritional data monitoring in public health emergencies like pandemics.

This research targets every regency and city within North Sumatra Province. The main goal is to analyze the number of children identified as having malnutrition. These figures serve as the primary data points because they give a clear picture of how many children are affected in each area. The study looks at two specific years: 2018 and 2023. By comparing the data from these years, it aims to show whether the number of malnourished children has gone up or down over time. The research lays particular emphasis on these two years because they mark key points before and after the height of the COVID-19 pandemic.

The pandemic caused many disruptions to daily life and health services. Schools closed, health clinics faced difficulties, and many families experienced economic hardship. All these factors could influence the rate of child malnutrition. For example, some children may have faced limited access to nutritious food or healthcare during this period. Tracking the data over these five years helps identify potential shifts in health trends. It also helps determine if the pandemic indirectly worsened or improved nutrition among children.

This approach is important because North Sumatra has diverse regions, each with its own challenges. Some areas might have better health infrastructure, while others could be more vulnerable due to poverty or remote locations. By comparing overall and regional data, researchers can pinpoint where malnutrition rates are rising or falling. This can guide policymakers to focus their efforts on the most affected communities.

Ultimately, this research aims to give a detailed understanding of the impact of recent events, especially the COVID-19 pandemic, on child malnutrition in North Sumatra. It hopes to identify patterns, track progress, and highlight areas needing more attention. By doing so, it can help inform better health policies and programs that are tailored to the needs of different regions within the province.

C. Data Analysis Procedure

The data analysis process was conducted in a thorough and organized way, primarily using Jupyter Notebook, a popular tool for data projects. This platform allows for combining code, visualizations, and notes all in one place, making the process easier to follow and adjust. The analysis was done using the Python programming language, which is well-suited for handling large amounts of data efficiently. Several key libraries in Python were used to support this work. Pandas, for example, was used to manage and modify the data sets. It helps load data, filter it, and reshape it as needed. SciPy's stats module provides tools for statistical tests, helping to find meaningful patterns or differences within the data set. Visualization libraries like matplotlib and seaborn were used to create charts and graphs that make it easier to understand what the data is showing at a glance.

The first step in the process was data cleaning. This involves checking the raw data for errors and inconsistencies that could affect the results. For example, irrelevant columns—like IDs or timestamps that don't matter for the analysis—were removed to focus only on useful information. Consistency in column names was checked carefully to avoid confusion later, fixing typos or varying formats. Empty rows and duplicate entries were also removed, since they can lead to inaccurate conclusions if left in. Empty rows might occur from data entry mistakes or system errors, while duplicates could happen during data collection. Removing these ensures the data set is accurate and reliable.

In detail, this cleaning stage is crucial because messy data can distort analysis results. For example, if duplicate records remain, they might give a false impression of more frequent events. If irrelevant columns are left untouched, they can clutter the dataset and slow down the analysis process. Ensuring column names match expected standards helps prevent errors when writing code to extract or analyze data, making the entire process smoother. The cleaning process involved running

scripts that automatically spotted and removed such issues, but also manual checks in case some problems slipped through. This step helps to produce a clean, consistent, and trustworthy dataset as a solid foundation for all further analysis.

After the 2018 and 2023 datasets were cleaned, they were merged based on the regency/city name column to ensure data alignment. The merged dataset was then filtered to retain only two main columns: the number of malnourished children in 2018 and in 2023. Before conducting a comparative test, a normality test was performed using the Shapiro-Wilk method to determine whether the data followed a normal distribution. The test result showed a p-value < 0.05, indicating that the data does not follow a normal distribution.

Based on these results, the Wilcoxon Signed Rank Test was used to test whether there was a significant difference in the number of malnourished children between 2018 and 2023. The Wilcoxon test was selected because it is non-parametric and suitable for paired data that is not normally distributed. The test result showed a p-value < 0.05, indicating a statistically significant difference between the pre- and post-pandemic data. This suggests that the COVID-19 pandemic had a tangible impact on changes in child malnutrition status in North Sumatra Province.

This procedure aligns with modern data science practices that emphasize efficiency, reproducibility, and the validity of analysis methods, as also implemented by Ni Putu Elis C. et al. [13] and Diansa Fitri et al. [14] in their research on the relationship between nutritional status and child health using non-parametric statistical approaches in Python.

III. RESULTS AND DISCUSSION

A. Dataset Collection

The data on malnutrition cases used in this study was obtained from the official website of the Central Statistics Agency (BPS) of North Sumatra Province [15]. The dataset includes annual data on the number of births, birth weights, and the number of children suffering from malnutrition per regency/city for the pre-pandemic period (2018) and the post-pandemic period (2023). Data from 2020 was excluded as it is considered a transitional phase at the onset of the COVID-19 pandemic. All data was accessed through regional health statistics publications and annual report summaries publicly available on the portal sumut.bps.go.id.

B. Data Preprocessing

Before conducting statistical analysis, the data obtained from BPS North Sumatra publications underwent preprocessing to ensure it was ready for analysis. The preprocessing steps included:

- Removing Unused Columns

  In this step, irrelevant columns such as the number of births, low birth weights, and treated infants were removed. This was done for both the 2018 and 2023 datasets.

- Renaming Columns

  Column names were adjusted, particularly the column containing the names of regencies and cities, which was initially labeled “Unnamed: 0” and needed to be properly renamed.

- Merging 2018 and 2023 Data

  The datasets from 2018 and 2023 were then merged to align data across years and enable direct comparison.

B. Statistical Analysis

Using the Wilcoxon Signed-Rank Test statistical method, a comparative analysis was conducted to examine the difference in the medians between the 2018 and 2023 data. The null hypothesis (H_0) assumed no change in the medians of the two datasets.

The test resulted in a test statistic value of 20.0, which is significantly smaller than the p-value threshold , with a resulting p-value of 5.04x10^-6 ($p < 0,05$), indicating a statistically significant difference between the two periods. This result shows that the number of malnutrition cases in North Sumatra significantly decreased after the COVID-19 pandemic, likely influenced by post-pandemic recovery programs, improved household income, and strengthened community nutrition intervention. The trend is visualized in the graph below:

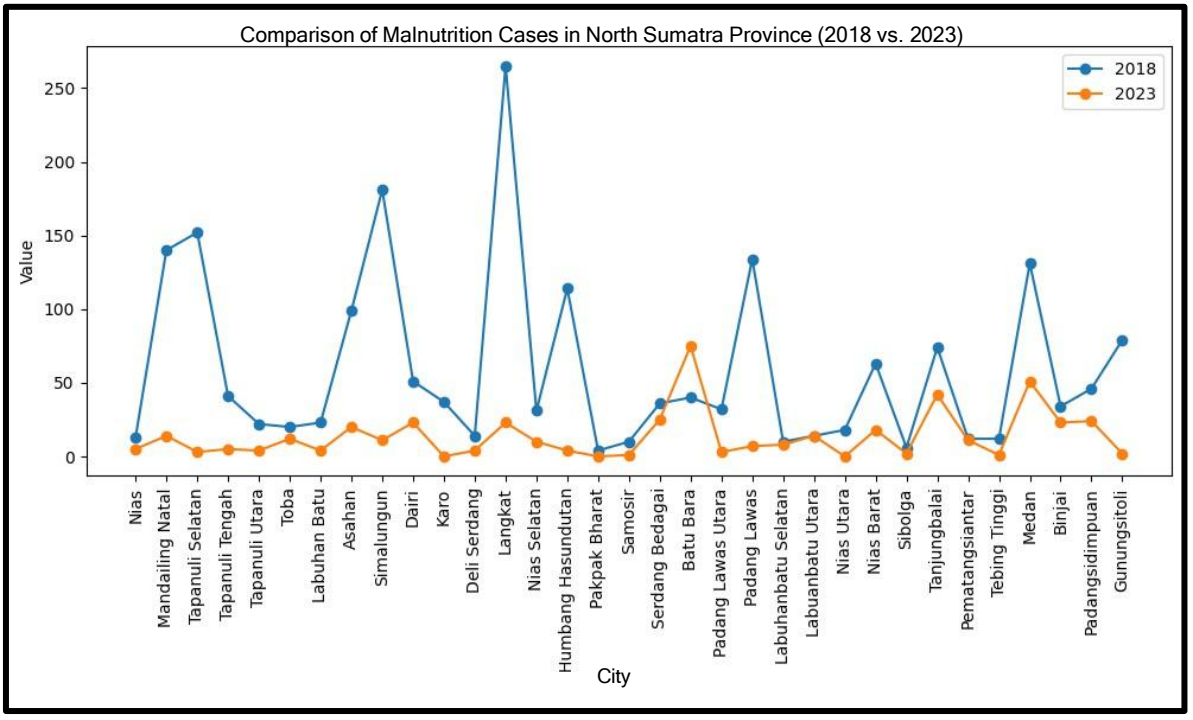

Figure 1. Comparison of Malnutrition Case Numbers in North Sumatra Province (2018 vs. 2023)

The graph clearly shows that the blue line, which depicts the number of malnutrition cases in 2018, has much higher numbers than the orange line representing data from 2023. This difference is evident throughout the entire period shown on the chart. The sharp decline in numbers from 2018 to 2023 suggests that fewer children in North Sumatera are suffering from malnutrition now than they were five years ago. This trend is significant because it indicates that efforts to reduce malnutrition have been successful over this period. For example, many local programs might have increased awareness about nutrition, improved access to healthy food, or provided better healthcare services for children.

The difference between the two lines isn't just small; it's quite substantial. In 2018, the counts of malnourished children hit a peak that might have alarmed health officials and community leaders, prompting action. By 2023, those numbers have fallen steadily, showing a clear positive shift in the health status of children across the region. This progress could be linked to government initiatives, community efforts, or increased investment in social services.

It's also important to understand why the statistic matters so much. Malnutrition, especially in children, hampers growth and development and can lead to serious health problems later in life. Seeing a visible decline in those cases signals that children are now healthier and more likely to have better futures.

This achievement highlights the power of targeted health programs and community support. It also encourages continued efforts, as these improvements can set an example for neighboring regions. Overall, the visual difference between the two lines on the graph symbolizes a meaningful step forward in battling malnutrition among children in North Sumatera.

CONCLUSION

Based on the statistical analysis, a test value of 20.0 with a p-value of 5.037031918484304e-06 was obtained, indicating a statistically significant difference in the number of infant malnutrition cases in North Sumatra before and after the COVID-19 pandemic. This is supported by findings from Elinda and colleagues in their study titled *"The Impact of COVID-19 on the Incidence of Stunting in the Working Area of Batunadua Public Health Center, Padangsidimpuan City"* [13], which stated that the decline was influenced by more structured government interventions during the pandemic. These interventions included food assistance programs, strengthening the role of health cadres at the community level, and utilizing digital child growth monitoring systems. Through this approach, families gained better access to nutrition, maternal health education improved, and early detection of growth problems became more effective. Overall, these efforts had a significantly positive impact in reducing the number of infant malnutrition cases in North Sumatra in the post-pandemic period.

REFERENCES

[1] Leviana, S. and Agustina, Y., 2023. Analisis Pola Makan dengan Status Gizi pada Siswa Kelas V SDN Jatiwaringin Bekasi. "*Malahayati Nursing Journal*", 5(2), pp. 12–20.

[2] Sinaga, T., Naibaho, D. and Pasaribu, I., 2017. Pengaruh Pendidikan Gizi Terhadap Pengetahuan, Praktik Gizi Seimbang dan Status Gizi pada Anak SD. Jurnal Gizi Indonesia, 6(2), pp. 35–43.

[3] Briliannita, A., Lestaluhu, S. A. and Supu, L., 2022. Pengaruh Pemberian Makanan Padat Gizi Terhadap Perubahan Berat Badan Anak Usia 5–6 Tahun. "*Ghidza: Jurnal Gizi dan Kesehatan*", 4(1), pp. 45–53.

[4] Santi, N. P. E. C., Wulandari, I. A. and Suarmini, N. K. A., 2023. Hubungan Status Gizi dengan Kejadian Anemia pada Anak Usia 6–59 Bulan. "*Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*", 13(2), pp. 78–85.

[5] Fitri, D., Sulistiyani and Antika, R. B., 2022. Pola Asuh Gizi terhadap Status Gizi Anak Balita Usia 6–24 Bulan. "*Jurnal Kesehatan Polije*", 8(1), pp. 10–17.

[6] Sinaga, S. E. N., 2023. Peningkatan Status Gizi Pada Siswa SMP Mardi Yuana Rangkasbitung. "*Jurnal Skolastik Keperawatan*", 4(1), pp. 22–29.

[7] Rizona, F., 2018. Pengaruh Edukasi terhadap Pengetahuan dan Sikap Jajanan Sehat Pada Anak Sekolah. "*Jurnal Keperawatan Sriwijaya*", 5(1), pp. 56–63.

[8] Ghozali, I., 2018. "*Aplikasi Analisis Multivariate dengan Program IBM SPSS 25*". Semarang: Badan Penerbit UNDIP, pp. 100–112.

[9] Trihendradi, C., 2011. "*Statistik Nonparametrik dengan SPSS*". Yogyakarta: Andi Publisher, pp. 75–89.

[10] World Health Organization, 2020. "*Nutrition and Food Security During the COVID-19 Pandemic*". Geneva: WHO, pp. 5–30.

[11] FAO and WFP, 2021. "*Impact of COVID-19 on Food Security and Nutrition*". Rome: FAO, pp. 15–48.

[12] Kementerian Koordinator PMK RI, 2022. "*Laporan Dampak Sosial-Ekonomi COVID-19 Terhadap Kesejahteraan Anak*". Jakarta: Kemenko PMK, pp. 40–65.

[13] E. Tarigan, A. J. Hadi, dan J. Sitorus, "Dampak Covid-19 Terhadap Angka Kejadian Stunting di Wilayah Kerja Puskesmas Batunadua Kota Padang Sidempuan," *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*, vol. 6, no. 2, pp. 157–164, 2023.

[14] S. S. M. Wara, A. F. Adziima , M. Nasrudin and A. R. Pratama , "Predictive Analysis of Government Application Comment on Playstore with Clustered Support Vector Machine ," 2024 IEEE 10 th Information Technology International Seminar (ITIS), Surabaya, Indonesia, 2024, pp. 84-88, doi: 10. 1109/ITIS64716.2024.10845453.

[15] A. Muhaimin, D. D. Prastyo and H. Horng-Shing Lu, "Forecasting with Recurrent Neural Network in Intermittent Demand Data," 2021 11th International Conference on Cloud Computing, Data Science & Engineering (Confluence), Noida, India, 2021, pp. 802-809, doi: 10.1109/Confluence51648.2021.9376880.