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## The increase of asthma self-medication in Indonesia during COVID-19 Pandemic: An infodemiology study using Google Trends

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### ABSTRACT

**Background and purpose:** The COVID-19 pandemic has significantly interrupted the care of asthma patients. In order to determine whether online search data and the number of COVID-19 cases were related, many Google Trends-based investigations were carried out throughout the pandemic. This study investigates whether asthma patients use the internet for self-management and treatment advice.

**Methods:** A netnographic approach with data sources from Google Trends was used in our research. The data were taken from [www.https://trends.google.co.id](https://trends.google.co.id) and were collected within two timeframes: (1) the beginning of COVID-19 (March 2, 2018-March 1, 2020) and (2) during the pandemic COVID-19 (March 2, 2020-March 1, 2022). The data is displayed graphically on a scale of 0 to 100, referred to as the Relative Search Volume (RSV). The Spearman correlation test on each keyword and the confirmed cases of COVID-19 in Indonesia were done in SPSS version 25 (IBM Corp., Armonk, NY) to determine if a correlation existed.

**Results:** This study found an increased search volume for asthma therapy. According to the correlation test results, the keywords "inhaler" and "nebulizer" significantly correlated with the number of confirmed COVID-19 cases. However, no link between asthma symptoms and the number of COVID-19 was found.

**Conclusion:** Indonesians sought more information on asthma self-medication during the rise of COVID-19, however not directly associated with the prevalence of the disease. Google Trends can become a potential source to explore people behaviour in relation to certain health information, however it cannot be used as the sole data collection tool for health research, especially in Indonesia.

**Keywords:** Asthma, Google Trends, COVID-19, Self-Medication

## INTRODUCTION

In early 2020, the world was caught off guard by an outbreak of unknown pneumonia that first appeared on December 31, 2019, in Wuhan, China. Further investigation revealed the presence of a virus known as "severe acute respiratory syndrome coronavirus 2," or SARS-CoV-2, which was later named COVID-19.<sup>1</sup> The COVID-19 pandemic is the most significant global public health challenge of this century, with the disease spreading rapidly across more than 190 countries and territories.<sup>2</sup> On March 2, 2020, it was announced that the Ministry of Health had identified the first case of COVID-19 in Indonesia. As of August 24, 2022, the total number of cases was 6,329,143, while the total number of deaths was 157,438.<sup>3</sup>

Meanwhile, asthma is a chronic medical condition that affects 1-18% of the global population. It is categorized as a heterogeneous condition marked by chronic airway inflammation.<sup>4</sup> It is generally accepted that virus infection can increase the risk of allergic diseases exacerbations, such as asthma. Asthmatic patients and those with other chronic lung disorders were initially considered at high risk of SARS-CoV-2 infection.<sup>5</sup> However, adults with asthma do not appear to be at increased risk of getting COVID-19, according to GINA (The Global Initiative for Asthma) Main Report 2022. Newer systematic reviews also have not found an increased risk of severe COVID-19 in people with well-controlled mild to moderate asthma.<sup>4</sup>

Choi et al. found convincing evidence that asthma is associated with increased mortality risk and poor clinical outcomes in COVID-19 individuals, with severe or intrinsic asthma being a risk factor for a poor prognosis.<sup>6</sup> Other studies have found that patients with severe asthma are more likely to die from COVID-19 and that asthma increases the chance of needing critical care in adults admitted to the hospital with COVID-19.<sup>7,8</sup>

According to emerging evidence and studies from prior national disasters, asthma care has been and will be significantly affected throughout the COVID-19 pandemic. Digital technologies, telemedicine, and telehealthcare are more commonly used to monitor asthma patients, particularly during the COVID-19 pandemic.<sup>4</sup> Moreover, self-management tools are increasingly taking the shape of digital interventions. Access to these tools may be easier for some people, but for some community groups, such as people with limited incomes, it is relatively difficult to access these health facilities because they are constrained by costs and elderly groups also tend not to use these health facilities because they are hampered by technological inadequacy.<sup>9</sup>

Google Trends is a tool that provides the relative volume of Google searches for specific terms depending on region and a timeframe defined by the user. Google Trends gives relative search volume data (on a scale of 0-100), which includes the number of searches for specific phrases compared to the total number of searches in the selected timeframe.<sup>10</sup> Several Google Trends-based studies were undertaken during the pandemic to determine whether online search data was associated with the number of COVID-19 cases, mortality, and mental health.<sup>11,12</sup>

Google Trends is one of the most effective trend analysis tools, focusing on the most frequently searched phrases by individuals, and it may be used to study and estimate people's interests and behaviors.<sup>13</sup> A study in Austria used Google Trends to determine whether individuals with COPD and/or asthma sought behavioral guidance on the internet during the COVID-19 pandemic.<sup>14</sup> The study conducted by Sousa-Pinto et al presents

an interesting anomaly in Google Trends online searches, namely that access to information about non-respiratory chronic diseases such as diabetes and hypertension is far greater than searches related to respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD) during the COVID-19 pandemic. The anomaly obtained is very valuable because it turns out that exposure to COVID-19 can threaten life safety when the patient has comorbid chronic diseases, especially diabetes and hypertension.<sup>15</sup> Therefore, using Google's search engine data analysis tool Google Trends (<https://trends.google.com/trends/>), the study aims to investigate if asthma patients had used the internet for self-management and treatment advice.

## METHOD

### Study Design and Google Trends data

This was a netnography study using the Google Trend Data. Google Trends is a Google service that calculates the volume of web searches for specific keywords at a given time. We assessed online searches for asthma disease and drugs for asthma. Asthma and medicines for asthma were chosen as specific keywords because they are related to respiratory tract diseases which are relatively closely related to the symptoms of exposure to COVID-19. These two specific keywords were searched for via Google Trends. The data were taken from [www.trends.google.co.id](http://www.trends.google.co.id) and were collected within two timeframes: (1) the beginning of COVID-19 (March 2, 2018-March 1, 2020) and (2) during the pandemic COVID-19 (March 2, 2020-March 1, 2022).

The authors searched for Relative Search Volume (RSV) of 14 asthma-related keywords in Indonesia, including drugs available in Indonesia: "asmakambuh" (asthma relapse), "napas mengi" (wheezing), "obatasma" (asthma medication), "inhaler", "turbuhaler", "nebulizer", "seretide", "berotec", "symbicort", "fluticasone/salmeterol", "ventolin", "pulficort", "combivent", and "salbutamol". The RSV data is displayed graphically on a scale of 0 to 100. To compare relative popularity, RSV is calculated by dividing total keyword searches by all represented searches on geography and time range.<sup>10</sup>

### COVID-19 data

The data was confirmed cases of COVID-19 in Indonesia, which were obtained from the following websites: <https://covid19.who.int/region/searo/country/id> (the World Health Organization, WHO) and <https://infeksimerging.kemkes.go.id> (the Indonesian Ministry of Health). The data were gathered from March 2, 2020 to March 1, 2022.

### Data Analysis

Search for data on COVID-19 cases and data collection for RSV was taken on a monthly basis. After obtaining the RSV from 14 keywords, the authors presented a graph comparing the RSV before and after COVID-19. Furthermore, the authors aligned both charts on RSV and COVID-19 to see if pattern similarities existed. Finally, the Spearman correlation test on each keyword and the confirmed cases of COVID-19 in

Indonesia were performed in SPSS version 25 (IBM Corp., Armonk, NY) to determine if a correlation existed. The Spearman correlation test was chosen because it is a non-parametric statistic which does not require the data to be normally distributed. The Spearman correlation test can also determine the relationship between two variables with ordinal data or one variable with ordinal data and the other in nominal or ratio form.

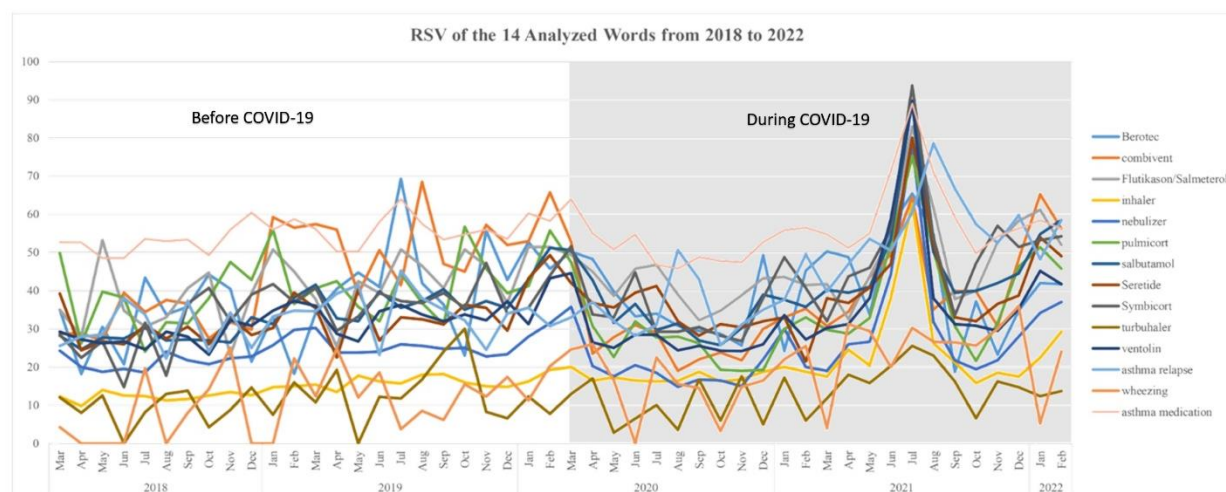
### Ethical Clearance

The study only used publicly available data from Google Trend ([www.https://trends.google.co.id](http://www.https://trends.google.co.id)), and the websites of WHO (<https://covid19.who.int/region/searo/country/id>) and Indonesian Ministry of Health (<https://infeksimerging.kemkes.go.id>), with no link to individual person, hence ethical clearance is not needed.

### RESULT

The authors used Google Trend to compare RSV (Relative Search Volume) before and after the emergence of confirmed COVID-19 cases in Indonesia by searching 14 keywords from March 2, 2018, to March 1, 2022 (Figure 1).

**Figure 1. RSV of the 14 Analyzed Words from 2018 to 2022**



Based on the Figure 1, it can be seen that in the 2018-2020 period before the COVID-19 case occurred, access to information regarding asthma medicines was still relatively at a normal level with RSV values in the range of 35. When the first case of COVID-19 in Indonesia was identified in March 2020, searches for the Combivent drug experienced a slight spike but remained relatively the same as the period in August 2019 before COVID-19 occurred. Moreover, during the COVID-19 pandemic, searches for all asthma medicines decreased quite drastically. Searches for new asthma medicines experienced a significant spike in the May-August 2021 period, which correlated with the peak of the COVID-19 pandemic, which was seen by the increasing number of deaths due to COVID-19. As a result, it is difficult to draw the typical pattern of changes before and after confirmed COVID-19 cases in Indonesia. Nonetheless, a similar pattern was discovered in 12 keywords which surged between June 2021 and August 2021.

**Figure 2. RSV of Common Symptoms of Asthma in Bahasa Indonesia and COVID-19 Cases in Indonesia**

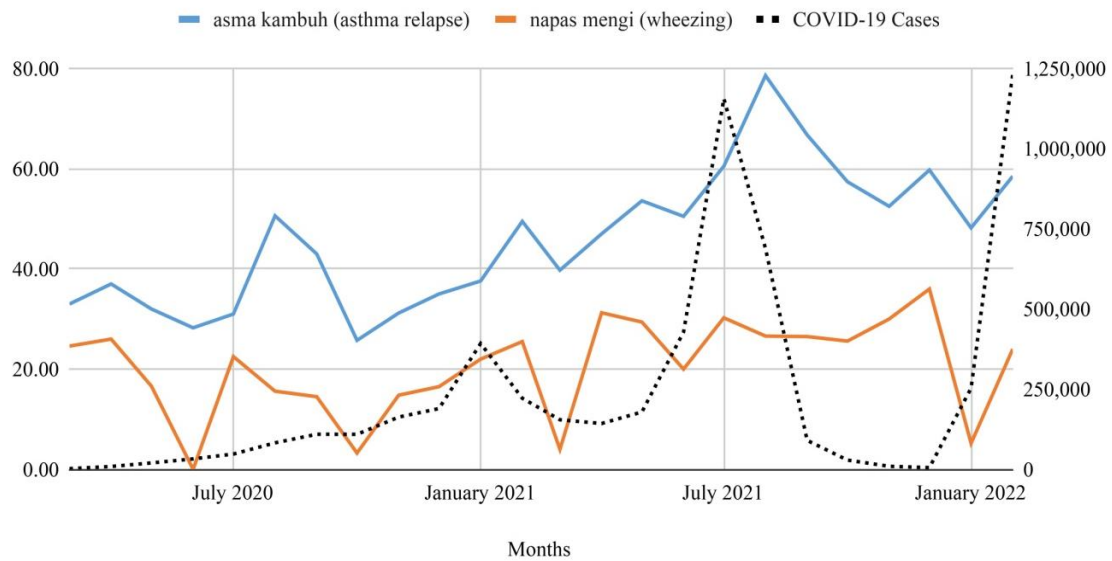
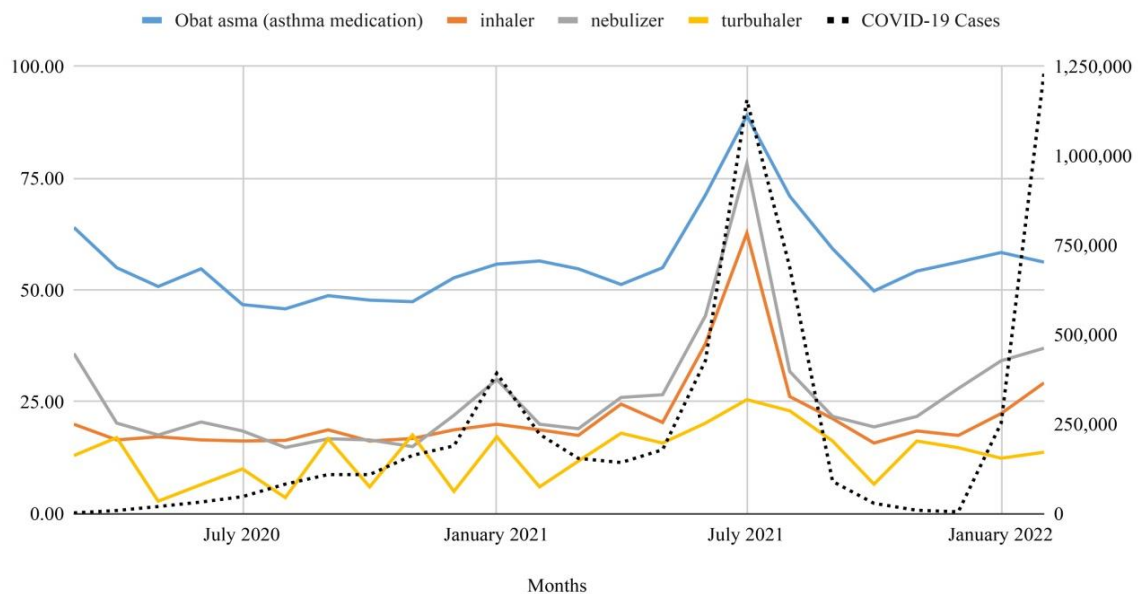


Figure 2 shows at the time the first case of COVID-19 occurred in Indonesia, namely in March 2020, searching about asthma recurrences actually decreased, even the symptoms of wheezing experienced a very drastic decrease. Furthermore, both respiratory symptoms experienced an increase, then both experienced a decrease in the period September 2020. Recurring asthma experienced a consistent increase which reached a peak in the period July-August 2021 which was related to the peak of the COVID-19 pandemic in Indonesia. The search of wheezing symptom remained relatively unchanged, even during the peak period of COVID-19.

**Figure 3. RSV of Choice of Therapy Keywords**



On Figure 3 can be seen that the search for information about medicines for asthma, including inhalers, nebulizers and turbuhalers, had decreased and remained relatively unchanged from the start of the first case of COVID-19 in Indonesia in March 2020 to May 2021. Searches for new asthma medicines including inhalers, nebulizers and turbuhalers experienced a significant increase in the June-August 2021 period in line with the peak of the COVID-19 pandemic in Indonesia.

**Figure 4. RSV of Words Depicting the Name of Asthma Drugs**

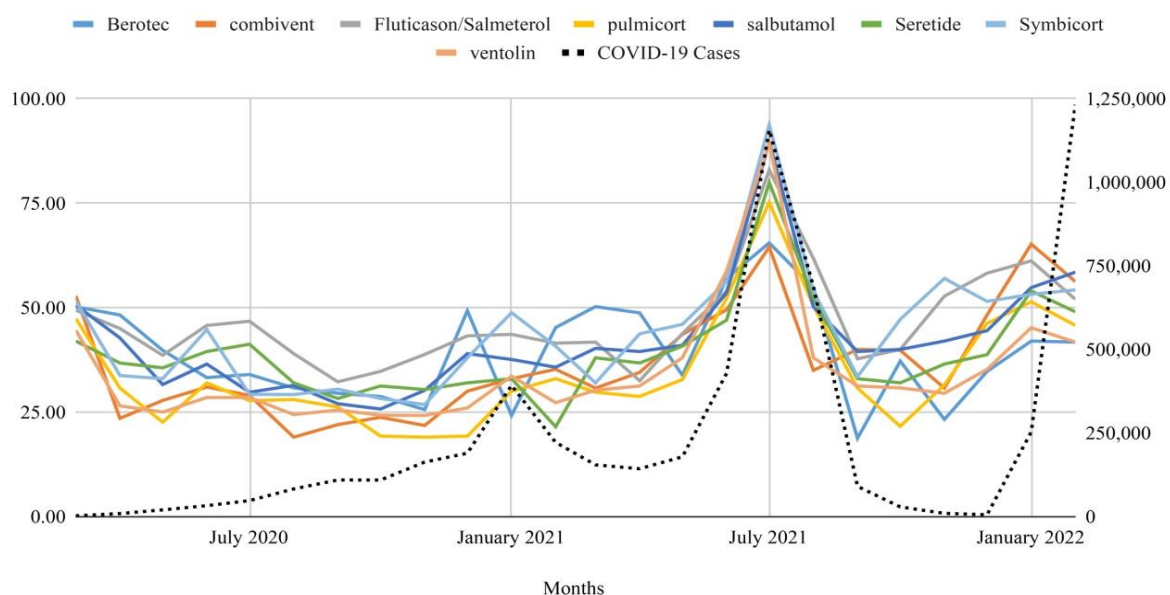


Figure 4 shows the RSV, the keywords on the commonly prescribed asthma medications, which are “berotec”, “fluticasone/salmeterol”, “symbicort”, “seretide”, “ventolin”, “pulmicort”, “combivent”, and “salbutamol”. These keywords showed a substantial increase in June 2021-August 2021 compared to the baseline.

To further investigate, the authors compared the RSV chart to the confirmed number of COVID-19 in Indonesia (Figure 2-4). The graphs portray a considerable increase, especially in January 2021, July 2021, and February 2022. The RSV—for the keywords such as “nebulizer”, “ventolin”, “symbicort”, “salbutamol,” and “pulmicort”—shows a similar pattern to the graph mentioned above, increasing in January 2021 and July 2021. At the peak of COVID-19 in Indonesia, which is in July 2021, the word “obat asma” (Asthma medication), “nebulizer”, “inhaler”, “berotec”, “seretide”, “ventolin”, “salbutamol”, and “fluticasone/salmeterol” show the same pattern. On the other hand, the keyword “asma kambuh” (asthma relapse) has a different pattern, peaking in September 2021 or after the graph of the COVID-19 figure drops back.

In addition, the authors performed a correlation test on the 14 keywords (RSV) with the confirmed number of COVID-19 in Indonesia. According to the correlation test results, the keywords “inhaler” and “nebulizer” had a significant correlation with confirmed COVID-19 cases (Table 1). The keyword “inhaler” obtained the correlation coefficient  $r = 0.671$ ;  $p < 0.001$  and the word “nebulizer” had the correlation coefficient  $r = 0.433$ ;  $p = 0.034$ . On the other hand, no significant results were obtained for the other keywords, the R-value ranging

from -0.074 to 0.386 and the p-value between 0.066 to 0.731.

**Table 1. Correlation of the RSV and the Number of COVID-19 Cases in Indonesia.**

Search Words	r	p-value
<i>Asma kambuh</i> (asthma relapse)	0.142	0.309
Berotec	0.129	0.319
Combivent	0.100	0.344
Flutikason/salmeterol	0.228	0.284
Inhaler	0.671	0.000
<i>Nafasmengi</i> (wheezing)	-0.074	0.731
Nebulizer	0.433	0.034
<i>Obat asma</i> (asthma medication)	0.386	0.062
Pulmicort	0.306	0.146
Salbutamol	0.267	0.208
Seretide	0.254	0.231
Symbicort	0.299	0.156
Turbuhaler	0.361	0.083
Ventolin	0.381	0.066

## DISCUSSION

Previous research has shown the robustness of Google Trends as a tool to predict outbreaks, monitor new infectious diseases (such as COVID-19), and as a data source for epidemiology.<sup>13,16,17</sup> In addition, an increased search for asthma therapy keywords, such as "inhalers" and "nebulizers," could indicate an increased number of people requiring both therapies. At that time, people with asthma may have more complaints, so they search for inhalers and nebulizers on Google to learn more about the therapy or how to get it. Furthermore, the rise in searches for "inhaler" and "nebulizer" does not rule out the possibility of purchasing non-prescription medicines. In Indonesia, the percentage of people buying drugs without a doctor's prescription is relatively high. For example, in the case of one pharmacy in Medan City, it was discovered that during the period March-May 2018, medicines for asthma were purchased in large quantities without a doctor's prescription, namely Teosal (250 tablets), Lasal (250 tablets, 40 bottles), as well as asthma medication for inhalers in the form of 2 Combivent and 113 Ventolin 2 mg.<sup>18</sup>

As in other developing countries, prescription drugs are sold in healthcare facilities, unregulated pharmacies, and unlicensed grocery stores. Most Indonesians self-medicate before seeking medical help, such as by purchasing antibiotics without a prescription.<sup>19</sup> However, in the case of asthma, a similar case to that of antibiotics has not yet been conducted. The following factors influence sales behavior and the use of antibiotics without a prescription: ease of access to drugs, cost savings, time savings, and pharmacist attitudes that allow the purchase of antibiotics without a prescription.<sup>20</sup> In fact, antibiotics, which should have been restricted, can be purchased freely in Indonesia, let alone other medicines. Thus, people may search on Google for these two keywords, intending to buy independently after a quick search.

The high number of COVID-19 cases, which makes people afraid to visit a hospital or medical clinic, also contributes to this self-medication behavior. According to Sevalia et al. (2021), one of the consequences of the COVID-19 pandemic is decreased hospitalization rates for non-COVID-19, surgical and non-emergency cases.<sup>21</sup> Because of the priority is placed on combating COVID-19, the changes to several regulatory policies also apply to non-emergency diseases. Furthermore, patients are hesitant to visit healthcare facilities for fear of infection.

Even though the two curves showed identical patterns from June to August 2021, the correlation test on 12 keywords which is based on diseases that are relatively identical to the symptoms of exposure to COVID-19 such as asthma flare-ups and wheezing as well as various medicines for diseases that are relatively well known and widely used by the general public that is "*asma kambuh*" (asthma relapse), "*obat asma*" (asthma medication), "nafas mengi" (wheezing), "seretide", "berotec", "symbicort", "fluticason/salmeterol", "ventolin", "pulmicort", "turbuhaler", "combivent," and "salbutamol" did not yield a significant result. On the contrary, Husnayain et al. (2019) discovered a significant correlation between RSV derived from dengue fever-related keywords and official dengue reports in Indonesia.<sup>22</sup> Wang and Tangs' study (2021) also finds a link between salmonellosis-related keywords and the number of confirmed salmonellosis cases, where the increase in RSV in these keywords appears first and is followed by an increase in salmonellosis rates. As a result, Google Trends data can predict outbreaks.<sup>23</sup>

The lack of correlation in the 12 keywords may be influenced by the health seeking behavior of Indonesian people, including looking for information about the correlation between COVID-19 and asthma. Then, asthma that is still mild is usually treated with traditional medicine such as herbal medicine or a drink mixed with honey and eggs or buying asthma medicine at an affordable price without a doctor's prescription. When it comes to health care, Indonesians are influenced by several intricate factors. It includes sociodemographic characteristics, significant others, sociocultural beliefs, perception of diseases and their causality, and perception of medical services covering the accessibility and availability in rural areas and their associated cost.<sup>19</sup>

There was no significant relationship between the keywords "*asma kambuh*" (asthma relapse) and "*napas mengi*" (wheezing) and the number of confirmed COVID-19 cases. In contrast, Chen et al. (2022) discovered a positive correlation between Google Trends from the keywords "loss of smell" and "loss of taste," and the number confirmed COVID-19<sup>24</sup> which also corresponds to Jimenez's research in Spain (2020). The Google Trends data is also valid for 11 days and can be used to forecast an increase or decrease in the number of COVID-19.<sup>25</sup> Meanwhile, in the United States, the Google Trends of symptoms can be used to predict COVID-19 since the previous three weeks.<sup>26</sup> In this study, however, no link between asthma symptoms and the number of COVID-19 was found. This might be due to a thorough understanding of the symptoms, as supported by Puspitasari (2021), who mentions the level of public knowledge on asthma in the Gresik area of East Java, Indonesia. With an average score of 76%, the correspondent demonstrated good knowledge of asthma symptoms and how to recognize asthma. However, the participants' knowledge of asthma treatment, particularly asthma therapy options and how to use inhalers, remains limited.<sup>27</sup>

There was no significant correlation found between the keywords "seretide," "berotec," "symbicort," "fluticason/salmeterol," "ventolin," "pulmicort," "combivent," and "salbutamol." Aside from formal health services, Indonesia offers a variety of treatments, including traditional medicines (natural biologic medicines)

and physical therapies with (such as acupuncture, acupressure, and cupping) or without tools (such as massage). Some Indonesians prefer traditional medicines over drugs because they fear drug side effects and dependence. This has been passed down through generations and is inextricably linked to the Indonesian people.<sup>19</sup> Similarly, Isnawati et al. (2019) also discovered that 89% of households kept traditional medicines at home as supplies.<sup>28</sup>

High searches for asthma drugs do not follow the high number for searching "nebulizer" and "inhaler." In Indonesia, treatment frequently involves the patient, extended family, friends, and other communities. Patients typically consult with non-medical groups or people they trust to determine the next steps in treatment.<sup>19</sup> Some even try the medicine based on a recommendation rather than a prescription. However, due to the lack of the most recent data on asthma rates in Indonesia, the preceding discussion is still far from complete. The most recent update was in 2019<sup>29</sup>, and during the COVID-19 pandemic, there was no data update. As a result, the frequency and severity of asthma exacerbation cannot be directly linked to the confirmed number of COVID-19. Additionally, the RSV of 14 keywords cannot be directly related to asthma rates. Furthermore, the insufficient data on asthma patients hospitalized during the pandemic prevented us from determining whether the RSV-keyword-related has no difference before and after COVID-19. During the pandemic, the exacerbation rate may have decreased or increased. As a result, rather than searching for information on Google, patients tend to go straight to the ER. Furthermore, asthma symptoms that resemble COVID-19, such as shortness of breath, may lead people to believe they are infected with COVID-19. In addition, the lack of integrated data on drug sales and purchases across Indonesia complicates this research. If such data is available, we can directly compare Google Trends for asthma medications such as "seretide," "berotec," "symbicort," "fluticasone/salmeterol," "ventolin," "pulmicort," "combivent," and "salbutamol" to the number of purchases in healthcare facilities and private pharmacies.

Further research needs to be done to analyze why the RSV of drug names and the actual COVID-19 cases are unrelated in this study. People might directly purchase the drugs without conducting a Google search, given the ease of obtaining drugs without a doctor's prescription in Indonesia.<sup>19</sup> Therefore, updating the data on chronic diseases, especially asthma, is critical. This is because asthma and some of the symptoms of COVID-19 relatively have a number of similarities, especially affecting the respiratory system. However, information and data regarding whether asthma can be linked with a worse prognosis of COVID-19 that endangers the health and safety of patients relatively less, even when compared with diabetes or hypertension which is only a comorbidity which is dangerous if the person concerned is exposed to COVID-19.<sup>15</sup>

The Third United Nations High-Level Meeting on Noncommunicable Diseases (NCDs) emphasized the significance of NCD surveillance as a foundation for decision-making in NCD management.<sup>30</sup> Purnamasari (2018) found an increase in NCDs in Indonesia, specifically cardiovascular disease, lung disease, and malignancy, in her research. This increase will almost certainly have a negative impact on health and quality of life.<sup>31</sup> Accordingly, the most recent NCD data in Indonesia must be updated. As an example, the asthma data was last updated in 2019. Many changes in asthma prevalence and incidence are likely to have occurred in the last three years, particularly since the introduction of COVID-19.

Moreover, updating epidemiological data on diseases will significantly aid programs of the Digital Transformation Office (DTO) of the Indonesian Ministry of Health. DTO is a team that will carry out the digital transformation of healthcare in Indonesia. DTO aims to ensure that all national health data, including medical

records and drug purchases, are integrated into a single secure database.<sup>32</sup>

Previous research has shown that Google Trends can be used as an outbreak predictor to provide an overview of the actual data.<sup>22,23</sup> Additionally, Sato (2021) revealed that GT could be used for epidemiology even though many studies may contain statistical errors. This is because they only use one data processing method, such as measuring correlations over a particular time without adjusting for other comparisons, the media coverage, for example. As a result, false positive correlations are common in Google Trends-based studies.<sup>33</sup> However, Google Trends can be used to help with surveillance data as we approach DTO 2024. It must become only an adjunct tool, with traditional epidemiological studies remaining the primary tool. Finally, while GT can be used to gauge public interest in specific health topics, it cannot be used as the primary data source for epidemiological studies in Indonesia.

Google Trends was utilised to explore data related to two respiratory system diseases such as asthma and chronic obstructive pulmonary disease (COPD) which have several symptoms similar to COVID-19 as well as non-respiratory system diseases which were identified as the most common comorbidities found in patients. COVID-19 increases the risk of death in these patients such as diabetes, hypertension, and Crohn's disease. Google Trends can be used to support COVID-19 pandemic management more effectively by epidemiologists in various countries with different situations.<sup>15</sup>

## CONCLUSION

Overall, data analysis revealed no distinctive patterns existed on the RSV on 14 asthma-related keywords, especially between pre- and post-COVID-19. Nonetheless, when COVID-19 reached its peak (June-August 2021), the pattern for Google Trends RSV, specifically 12 out of 14 asthma-related keywords, showed an identical increase to the number of confirmed COVID-19, albeit it was not statistically significant.

The correlation test yielded a significant result for two keywords, “inhaler” and “nebulizer,” both of which are therapeutic options for asthma relapses. It suggests that people sought self-medication during the rise of COVID-19. Likewise, insignificant keywords (12 of 14) revealed Indonesians’ heterogeneous and complicated health-seeking behavior. To date, many of them possibly seek non-medical treatment, non-doctor consultation, and purchase their own medicine. Given the ease of obtaining medicine without a prescription, they are also unlikely to browse Google Search thoroughly.

Google Trends has a potency to support disease surveillance including in the pandemic situation such as COVID-19, however, it cannot be used as the sole data collection tool in Indonesia. It can be considered a supporting tool for conventional epidemiology, assisting data surveillance and, in particular, supporting the implementation of DTO 2024.

## COMPETING INTEREST

The authors declare that they have no conflict of interest.

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## AUTHOR'S CONTRIBUTION

HS, AR, NRH arranged the research, collected, and analyzed the data. AR, NRH, GSA provided input on research concepts and designs. HS and AR conducted the statistical analysis and wrote the first draft of manuscript. DPL, NAP double-checked the results, discussions and edited the manuscript. GSA supervised the study and provided feedbacks.

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