nafas × halodoc

Air Pollution Can Increase Respiratory Illness Diagnosis by up to 34%

SEPTEMBER 2023

Background
Nafas and Halodoc

The well-being of its citizens is pivotal for a nation's progress.

Indonesia has a mission to strengthen public health, which is one of the targets of social transformation to achieve the vision of Indonesia Emas 2045. To accelerate the realization of the goal, it is essential to have support and collaboration across sectors to ensure that health aspects are the right of all Indonesian people inclusively under any conditions, even amidst uncertain air pollution conditions.

Air pollution has been a concern of the public in recent years, but starting in mid-2023, air pollution conditions have garnered attention due to worsening conditions and significant impacts on public health. Addressing air pollution requires long-term commitment from various parties. "Nafas," as one of the air quality monitoring ecosystems in Indonesia, is collaborating with Halodoc, a digital healthcare service ecosystem, to provide education on the health impacts of air pollution.

This report aims to provide the latest insights into the air pollution conditions in Jakarta greater area through statistical methods initiated by Nafas. The report also presents various findings regarding air pollution components and its potentially impact health. In this report, there are recommendations and appropriate steps to maintain health amid air pollution from experts. Additionally, it discusses the short-term effects of worsening air pollution on health.

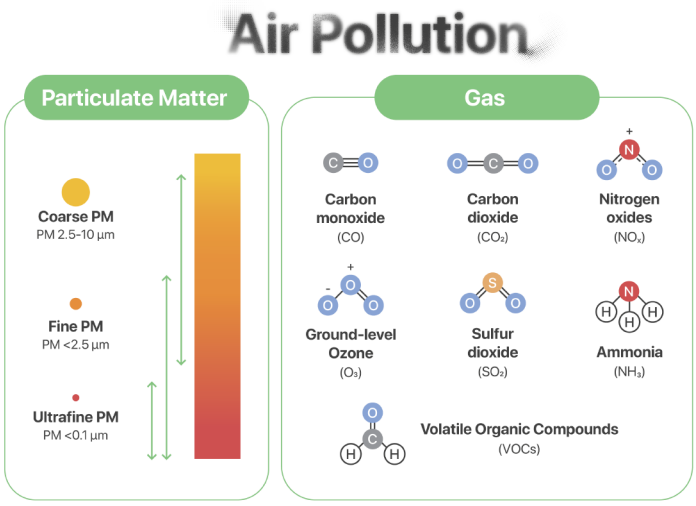
This report is a limited study, and the data used are only from Nafas and Halodoc, intended for a specific audience. This collaborative endeavor by Nafas and Halodoc aims to foster awareness regarding air pollution among Indonesians and motivate them to take proactive steps to safeguard their health.

1

Local Studies on Health Impact of Air Pollution is Needed

Air pollution has harmful impacts on humans and other living organisms. According to a study conducted by the Air Quality Life Index (AQLI) in 2022, the Life Expectancy (LE) of the Indonesian population could decrease by an average of 2.2 years if they continue to inhale air pollution.

Indonesia is one of the countries contributing three-quarters of the global air pollution burden (Air Quality Life Index, 2023). Unfortunately, public awareness of the health risks of air pollution remains limited. This is a critical issue because access to hyperlocal air pollution data is still challenging to obtain, and the number of local research studies examining the health impacts of air pollution in Indonesia is still relatively small.



The adverse health effects of air pollution have dire economic consequences, as reflected in the substantial healthcare expenditures it generates. A study conducted by Syuhada et al. (2023) reveals that the health impacts of exposure to fine particulate matter (PM2.5) and ground-level ozone (O_3) in Indonesia result in over 7,000 child injuries, 10,000 deaths, and 5,000 hospital admissions linked to Jakarta's air pollution every year. The healthcare cost losses due to air pollution effects amount to USD 2,943.42 million annually (Syuhada et al., 2023, 11).

According to the World Health Organization (2021), air pollution causes approximately 7 million deaths worldwide each year. The primary factor contributing to the global disease burden is exposure to PM2.5, also known as fine particulate matter. On the other hand, the World Bank (2021) states that for decades, numerous global studies have demonstrated the severe health risks associated with PM2.5.

Research related to the short-term and long-term impacts of PM2.5 exposure has been conducted by several countries like China and Korea often publish studies on the health impacts of PM2.5, and some of these findings contribute to the development of public policies. Some studies have found associations between PM2.5 and stunting in East Africa, where a 10 µg/m³ increase in PM2.5 is associated with a 9% increase in stunting (Clarke et al., 2022).

Several studies conducted in Indonesia have examined the relationship between PM2.5 and its chemical composition, as well as its potential health risks. For example, studies have shown that exposure to PM2.5 during forest fires in the Riau Islands poses a risk of causing cancer primarily due to heavy metals such as Chromium (Cr) and Cobalt (Co) in 2022 (Siregar et al., 2022). Another study found a link between an increased risk of diabetes mellitus and PM2.5 exposure, with every 10 µg/m³ increase in Indonesia (Suryadhi et al., 2020).

Research on the percentage of disease risks caused by PM2.5 for various diseases in Indonesia still needs to be expanded. One study conducted in Indonesia showed that every 1 µg/m³ increase in PM2.5 is associated with a 0.34 mg/dL increase in fasting glucose levels, and this impact is more pronounced in participants with hypertension and high physical activity levels in Yogyakarta (Yu et al., 2019).

Respiratory diseases are a major public health concern that imposes a significant disease burden on the population (Lancet, 2018). The two most dominant risk factors for respiratory diseases are behavioral factors (e.g., smoking) and environmental factors (e.g., air pollution) (Li et al., 2017). Many studies further explore the relationship between PM2.5 and respiratory diseases, but only a small fraction of these studies are conducted in Indonesia. Therefore, further research on the impact of PM2.5 on respiratory diseases is needed.

This analytical report aims to complement existing studies and serve as an additional reference and educational tool for the public regarding PM2.5 and its potential impact on respiratory diseases in the Jakarta greater area.

Considering the limitations of existing research, we have initiated local studies because:

1. Many studies emphasize the short-term effects of air pollution on respiratory diseases, but most are conducted in countries with relatively low average air pollution levels.

2. There is a lack of local studies conducted in Indonesia that address the short-term impact of PM2.5 on respiratory diseases.

Therefore, Nafas has collaborated with Halodoc to conduct limited research with the following objectives:

1. To complement existing studies on PM2.5 and its potential impact on respiratory diseases.

2. To provide additional insights about the health impact of air pollution on respiratory diseases in Jakarta greater area.

2

Methodology

The method employed in this study is statistical analysis. This method examines the relationship between PM2.5 and the average complaints of respiratory disease on the Halodoc application during the period of June to August 2023.

1. Nafas collects real-time air pollution data from low-cost sensors distributed across 180 locations in Indonesia. PM2.5 exposure is the primary focus of this study because it has the potential to contribute to disease burdens (WHO, 2021). In this study, PM2.5 measurements are in units of µg/m³.

2. Nafas uses air quality index to give an understanding of the inhaled air pollution using color codes. This study employs the US EPA's Air Quality Index (AQI), taking into account health impacts on sensitive groups (PM2.5 in the range of 35 - 55 µg/m³), such as children, elderly, pregnant women, and sensitive individuals.

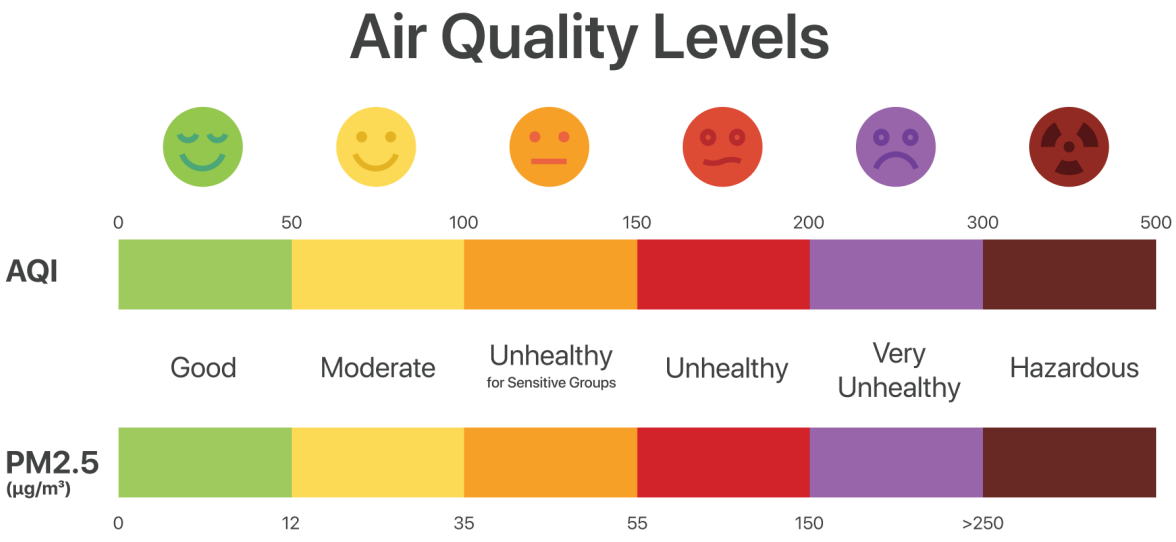


Figure 1.
US EPA Air Quality Index Categories Based on PM2.5 Concentrations Utilized by Nafas.

3 Nafas collaborated with Faculty of Public Health at University of Indonesia to determine ICD10 codes for respiratory disease that frequently associated with PM2.5, specifically ICD10-J.

Asthma	Bronchitis	Influenza	Rhinitis	Sinusitis	Others			
J45	J18.0	J10	J30	J32	J25.2	J33.0	J37.0	J69
J45.0	J20	J10.0	J30.3	J32.0	J12	J33.9	J37.1	J80
J45.1	J20.3	J10.1	J30.1	J32.9	J12.1	J34	J38	J81
J45.9	J20.6	J10.8	J30.2		J12.8	J34.0	J38.2	J84
J46	J20.9	J11	J30.3		J13	J34.2	J38.3	J84.1
	J21	J11.1	J30.3		J15	J34.3	J38.4	J90
	J21.9	J11.1	J30.4		J17	J34.8	J39	J93
	J40		J31		J18	J35	J39.3	J94
	J41		J31.0		J18.8	J35.0	J39.8	J98
	J41.0				J18.9	J35.1	J39.9	J98.6
	J41.1				J22	J35.2	J43	J98.9
	J42				J31.1	J35.9	J44	
	J47				J31.2	J36	J44.1	
	J98.0				J33	J37	J44.9	

Table 1.
ICD10-J List of Diseases: Asthma, Bronchitis, Influenza, Rhinitis, Sinusitis, and Others

4 Nafas selected time frame with highest pollution months. June to August 2023 shows the increasing trend of pollution, making these months as the chosen study duration.

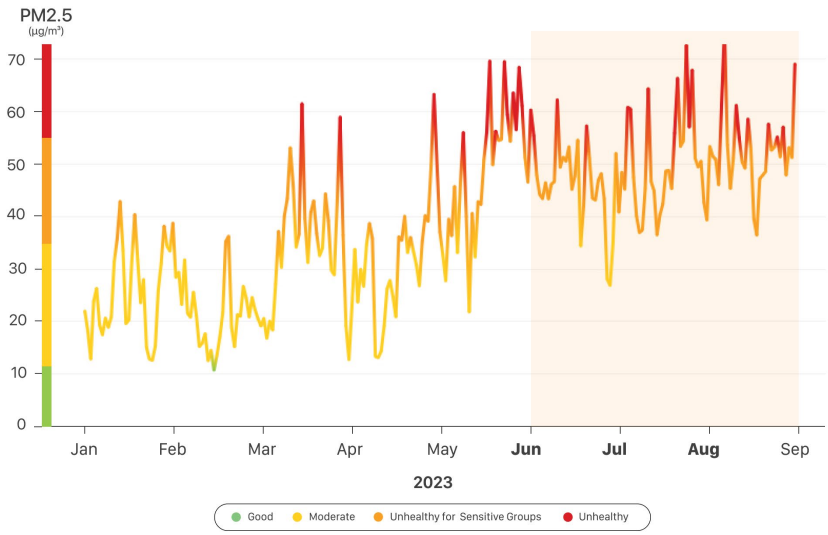


Figure 2.
PM2.5 Pollution Trends in Jakarta Greater Area from January to August 2023.

5 Nafas collaborated with Halodoc to gather anonymized information on the average complaints of diseases, including the time and location in the Jakarta greater area region. The spatial demographic distribution of Halodoc users is not considered in this study. This study only represents a sample of teleconsultation cases on the Halodoc application during June to August 2023. Teleconsultation cases related to respiratory complaints can be caused by various factors, one of which is the user's health condition. The information provided is solely used for educational and research purposes.

6 This study combines information collected by Nafas regarding the distribution of sensor locations in 73 districts in Jakarta greater area and information collected by Halodoc from June to August 2023.
The study's locations can be seen on the map and table below.

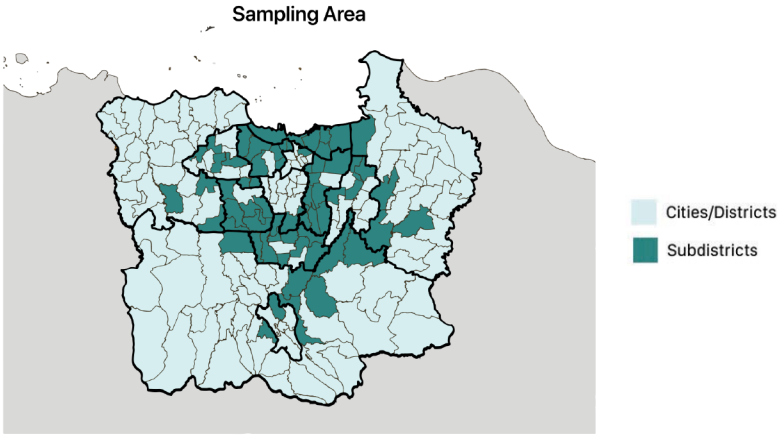


Figure 3.
Map and Table of the Jakarta Greater Area Showing Selected Locations Based on Nafas Sensor Distribution.

City / District	Subdistrict
Bekasi	Bekasi Selatan Bekasi Utara Cikarang Selatan Medan Satria Pondok Gede Tambun Selatan Tarumajaya
Bogor	Babakan Madang Cibinong Cileungsi Ciomas Gunung Putri Gunung Sindur Sukaraja Tanah Sereal
Depok	Beji Bojongsari Cimanggis Cinere Limo Sawangan Sukmajaya Tapos
South Tangerang	Ciputat Ciputat Timur Pamulang Serpong Serpong Utara Setu
Tangerang	Ciledug Cipondoh Cisauk Larangan Neglasari Panongan Periuk Tangerang

City / District	Subdistrict
Central Jakarta	Kemayoran Menteng Tanah Abang
East Jakarta	Cakung Cipayung Ciracas Duren Sawit Jatinegara Kramat Jati Makasar Pulo Gadung
North Jakarta	Cilincing Kelapa Gading Koja Pademangan Penjaringan Tanjung Priok
South Jakarta	Cilandak Jagakarsa Kebayoran Baru Kebayoran Lama Mampang Prapatan Pasar Minggu Pesanggrahan Tebet
West Jakarta	Cengkareng Grogol Petamburan Kalideres Kebon Jeruk Kelapa Dua Kembangan Palmerah Taman Sari Tambora

7 Nafas conducted an analysis of PM2.5 conditions in June, July, and August 2023 in various districts scattered across Jakarta greater area based on information gathered by the Nafas sensor network.

Nafas established a baseline (lower limit) for the average hourly PM2.5 concentrations below 35 µg/m³ or PM2.5 values falling into the Good and Moderate categories. The Good and Moderate categories were chosen because they are assumed to represent PM2.5 values that are relatively safe for human inhalation before entering the Unhealthy for Sensitive Groups category.

8 Nafas merged two sets of data: PM2.5 concentration and the average complaints of respiratory diseases on Halodoc from June to August 2023 to determine if there is a correlation between PM2.5 and respiratory disease cases in the selected districts.

One way to do this is by using the following formula:

$$y = kx$$

- y — Average complaints of respiratory diseases on Halodoc.
- k — Proportional constant.
- x — Baseline PM2.5.

Using direct variation, the percentage increase in respiratory disease cases due to PM2.5 increment is determined. The analysis is calculated with a threshold for every 10 µg/m³ increase, indicating significant changes.

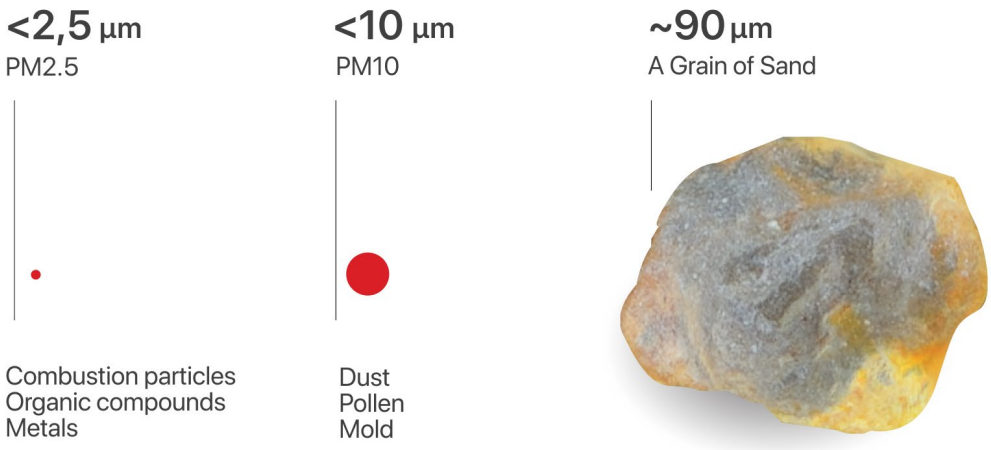
A descriptive analysis method is employed at this stage with the objective of analyzing the relationship between PM2.5 and the average complaints of respiratory diseases on Halodoc. Subsequently, the impact of PM2.5 increment on the rise in cases of each disease during the period from June to August 2023 is also examined.

3

PM2.5, Poses Biggest Health Risks

According to the World Health Organization (WHO), PM or Particulate Matter is a pollutant that poses a significant threat to human health based on its contribution to the disease burden it causes.

PM is divided into PM10 and PM2.5, which are differentiated by particle size. These particles are extremely small, being 20 times smaller than a single hair and 36 times smaller than a grain of beach sand.



*Diameter in milimicron

Of the two particle sizes, PM2.5 is considered much more dangerous to health due to its extremely small size, which makes these pollutants impossible to be filtered by our bodies. PM2.5 can enter the body through the lungs and bloodstream, subsequently affecting various organs.
In 2021, the World Health Organization (WHO) revised the safe thresholds for various pollutants. For PM2.5, the annual average baseline was tightened from 10 µg/m³ (2005) to 5 µg/m³ (2021), and the daily average from 25 µg/m³ (2005) to 15 µg/m³ (2021).

3.1

Types of Air Pollution Sources

PM2.5 pollution sources can originate from natural and anthropogenic sources.

Typically, anthropogenic sources are of greater concern as they are dominated by the incomplete combustion of fossil fuels to biomass, and they have significant impacts on human health.

Based on Vital Strategies (2019), PM2.5 sources originate from various sources with different chemical compositions. The following sources contribute to PM2.5 pollution in Jakarta:

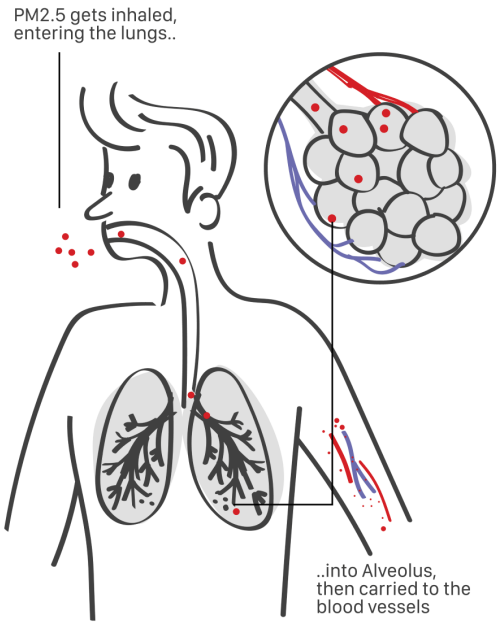
- Motor vehicle 32-57%
- Open burning 9-11%
- Coal burning 14%
- Construction activity 13%
- Road dust 1-9%
- Aerosol 1-16%
- Sea salt 1-22%

4

The Hidden Health Risks of PM2.5

PM2.5 particles are extremely small. When inhaled by humans, they can be difficult for the body to filter out and may even enter the bloodstream.

Discoveries of particulate matter within the human body have been made, including black particulate matter in the lymph nodes of the lungs (Ural et al., 2022) and respiratory tract cells (Lakhdar et al., 2022).



Simulation of PM2.5 entering and poisoning the body

Although PM2.5 pollution is invisible to the human eye, it has health impacts on humans, especially sensitive groups such as the elderly, children, pregnant women, and people with respiratory problems.

Over a certain period, exposure to PM2.5 that enters the body can lead to various health symptoms. The symptoms vary due to the type and composition of PM2.5 and the duration of exposure, and other factors like genetics, diet, and behaviors like smoking also contribute.

The health effects vary among individuals, with some experiencing short-term effects that can be felt within minutes, hours, or days, while others may experience long-term effects over months to years.

4.1 Short-term Health Impacts of PM2.5

Based on several short-term studies, for every 10 µg/m³ increase in PM2.5, the risk of respiratory diseases increases as follows:

Asthma	→ 1,7% increased risk of emergency room visits for asthma in adults and 3,6% in children (Fan et al., 2015)
Rhinitis	→ 0,47% increase in doctor visits for outpatient allergy rhinitis on the same day (Wang et al., 2020)
COPD (Chronic Obstructive Pulmonary Disease)	→ 2,5% increased COPD-related deaths and a 3,1% increase in COPD hospitalizations (Li et al., 2016)
Bronchitis	→ 15-32% increase in medical management for acute lower respiratory infections in bronchitis patients (Horne et al., 2018)
ARIs (Acute Respiratory Infections)	→ **Sinusitis** • 0,48% increase in hospital outpatient treatment for chronic sinusitis in children under 15 (Lu et al., 2020) → **Influenza** • 14,7% increased risk of influenza in 6 days (Zhang et al., 2022) • 16% increased risk of Influenza-like illness (ILI) on a weekly average (Toczylowski et al., 2021)

4.2 Long-term Health Impacts of PM2.5

For long-term exposure to PM2.5, the impacts can be felt over months to years and result in several serious health problems.

Some studies indicate that for every 10 µg/m³ increase, there is an increased risk of various diseases, including:

Lung Diseases and Disorders	→ **6,5%** increased risk of lung cancer mortality (Yang et al., 2023) → **34%** increased risk of lung cancer (Miller et al., 2016) → **4,47%** reduction in vital lung capacity (Chen at al., 2019)
Tuberculosis (TB)	→ **0,9%** increase in TB cases after three months of exposure (Yang et al., 2020)

4.3 Not Only a Respiratory Issue

Exposure to PM2.5 can also exacerbate other health problems, such as the risk of skin diseases, heart attacks, cognitive function impairment, stunting in children, preterm birth, and low birth weight.

Some studies indicate that for every 10 µg/m³ increase, the following health issues may be affected:

Cardiovascular Diseases

- → **12-14%** increased risk of cardiovascular diseases (Goldberg et al., 2008)
- → **3%** increased risk of cardiovascular events related to heart attacks, strokes, and sudden cardiac death (Jalali et al., 2021)
- → **23%** increased risk of death from ischemic heart disease, **13%** from stroke, and, **8%** from heart attack in long-term exposure (Alexeeff et al., 2021)

Pregnancy Complications

- → **48.4 gram** grams reduction in fetal weight during pregnancy exposure (Savitz et al., 2014)
- → **11%** increased risk of miscarriage, with the risk increasing with gestational age (Xue et al., 2022)
- → **26%** increased risk of preterm birth with pregnancy exposure (Zhang et al., 2020)

Children

- → Stunting
  - **19%** increased risk of stunting among children aged 5 or under (Pun et al., 2021)
- → ADHD *(attention-deficit hyperactivity disorder)*
  - **19%** increased risk of ADHD in the first three years of life (Chang et al., 2022)

Skin Diseases

- → **5.1%** increased medical visits for atopic dermatitis in children with weekly PM2.5 increases (Fadadu et al., 2023)
- → **2.71%** increased outpatient visits for eczema per month (Park et al., 2021)
- → **1.71%** outpatient visits for acne vulgaris from 120,842 patients in China (Ding et al., 2017)

5

Results

This study examined the concentration of PM2.5 exposed at key points in Jakarta greater area and the trends in respiratory -related complaints. The study attempted to investigate the relationship between the two variables through various approaches, including:

- The increase in PM2.5 concentration on average respiratory cases
- The increase in PM2.5 concentration on average respiratory cases at the district level
- The increase in PM2.5 concentration above 55 µg/m³ in a short period
- The increase in PM2.5 concentration for 5 types of respiratory diseases in a short period
- The increase in PM2.5 concentration based on age group risk

The concentration of PM2.5 pollution can affect the health of residents living in the study area. This is because the characteristics of PM2.5 patterns vary from place to place, influencing the level of human exposure. Differences in PM2.5 pollution concentrations depend on weather, microclimate, geographic location, topography, inherent and local pollution sources (Zhan et al., 2019).

Finding 1

The trend of respiratory teleconsultations increased by 34% for every increase of 10 µg/m³ PM2.5

Based on direct variation calculations with a proportional constant, Based on direct variation calculations, for every 10 µg/m³ increase of PM2.5 concentration from a baseline of 31 µg/m³ potentially increase the respiratory complaint cases by up to 34%.

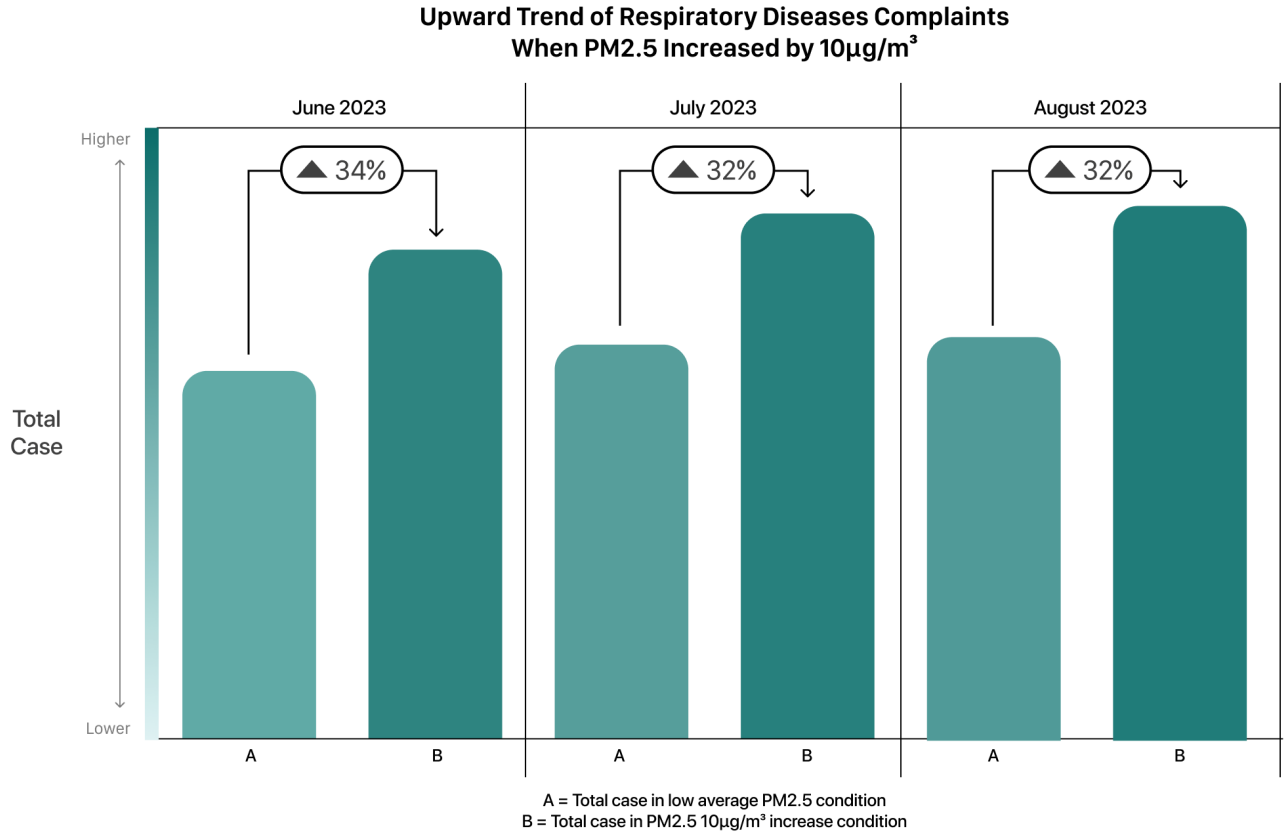


Image 4.
Percentage Increase in Average Respiratory Disease Cases for Each 10 µg/m³ PM2.5 Increase in June, July, and August 2023.

During the year 2023, there was a significant increase in PM2.5 concentration above the baseline in June, July, and August. At the same time, this study found that it potentially led to an increase in the average respiratory disease complaints in June by 34% and in July-August by 32%.

Finding 2

As pollution increased, respiratory disease teleconsultation in each district increased by up to 41%

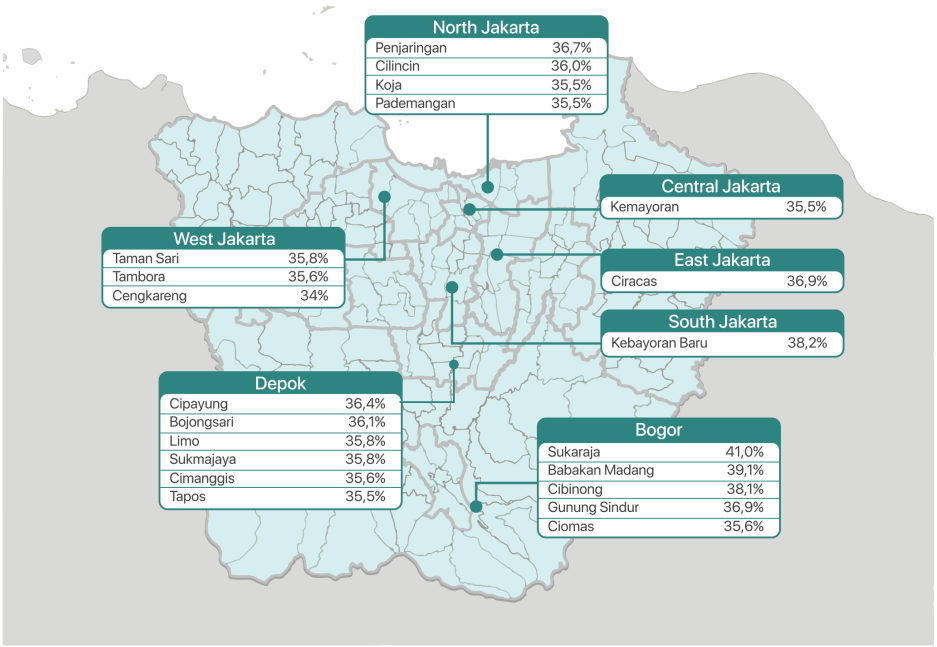
Based on data collected from 73 districts in Jakarta greater area, there were 20 districts with the highest percentage increase in respiratory complaints based on a 10 µg/m³ increase in PM2.5.

Percentage of Average Complaints per District in June-August 2023

Through direct variation calculations with a proportional constant, it was found that there was an increase in the percentage of respiratory disease complaints in several areas in Jakarta greater area by 30.6% - 41%.

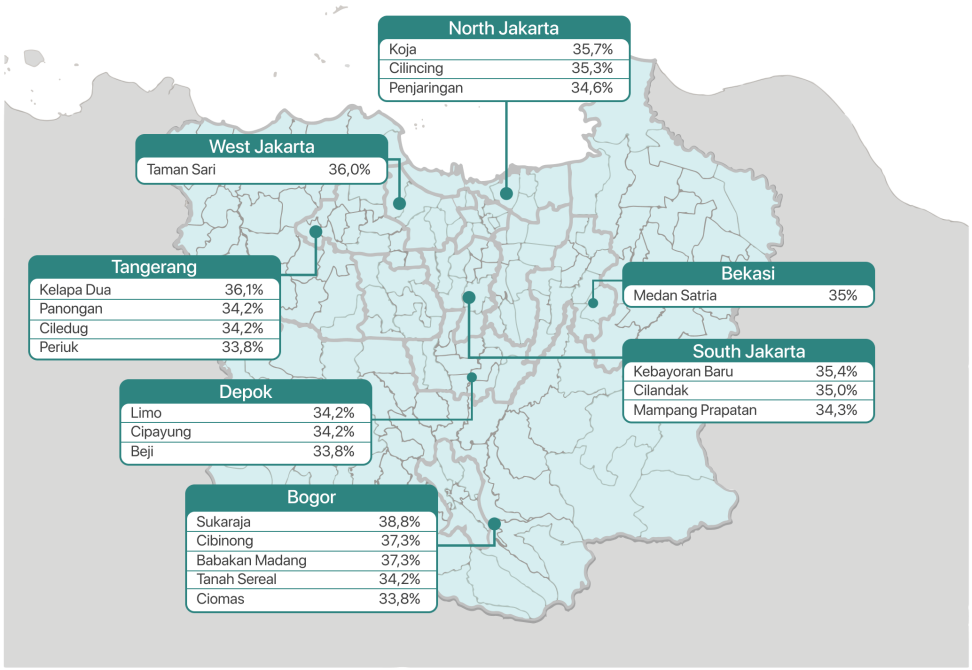
Meanwhile, when compared to all district data, June had the highest percentage of respiratory complaints, while August had the lowest percentage of complaints.

Consultations Percentage Increase by Subdistrict
June 2023



Consultations Percentage Increase by Subdistrict

July 2023



Consultations Percentage Increase by Subdistrict

August 2023

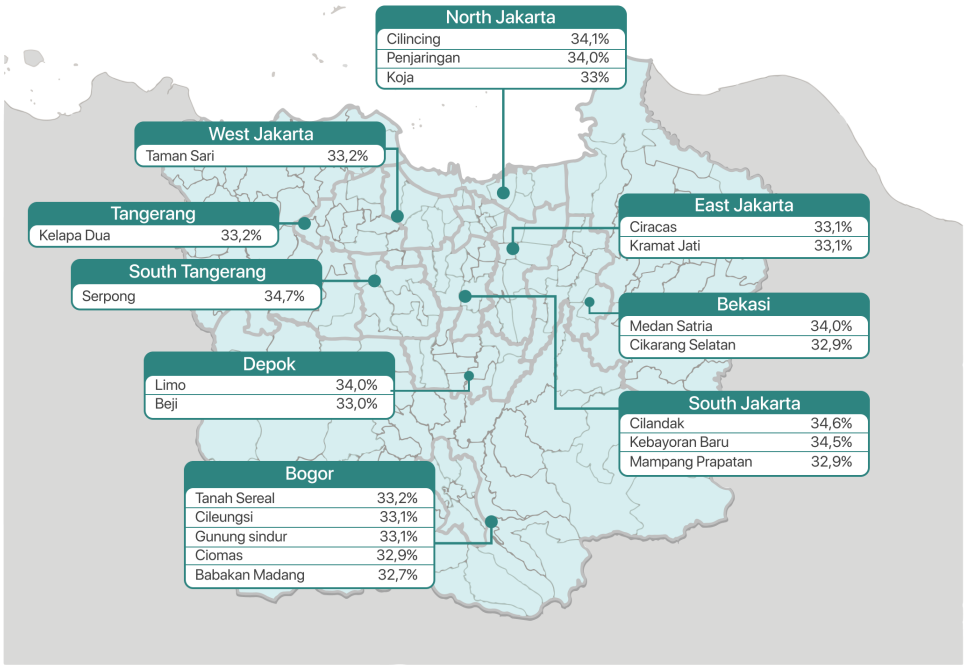


Image 5.
Map of the percentage of teleconsultations for the top 20 districts with the highest increase for every 10 µg/m³ increase in PM2.5 in (a) June, (b) July, and (c) August 2023.

Percentage of Average Complaints per Cities in June-August 2023

Many areas in Jakarta greater area experienced an increase in the percentage of respiratory disease complaints as shown in the following image.

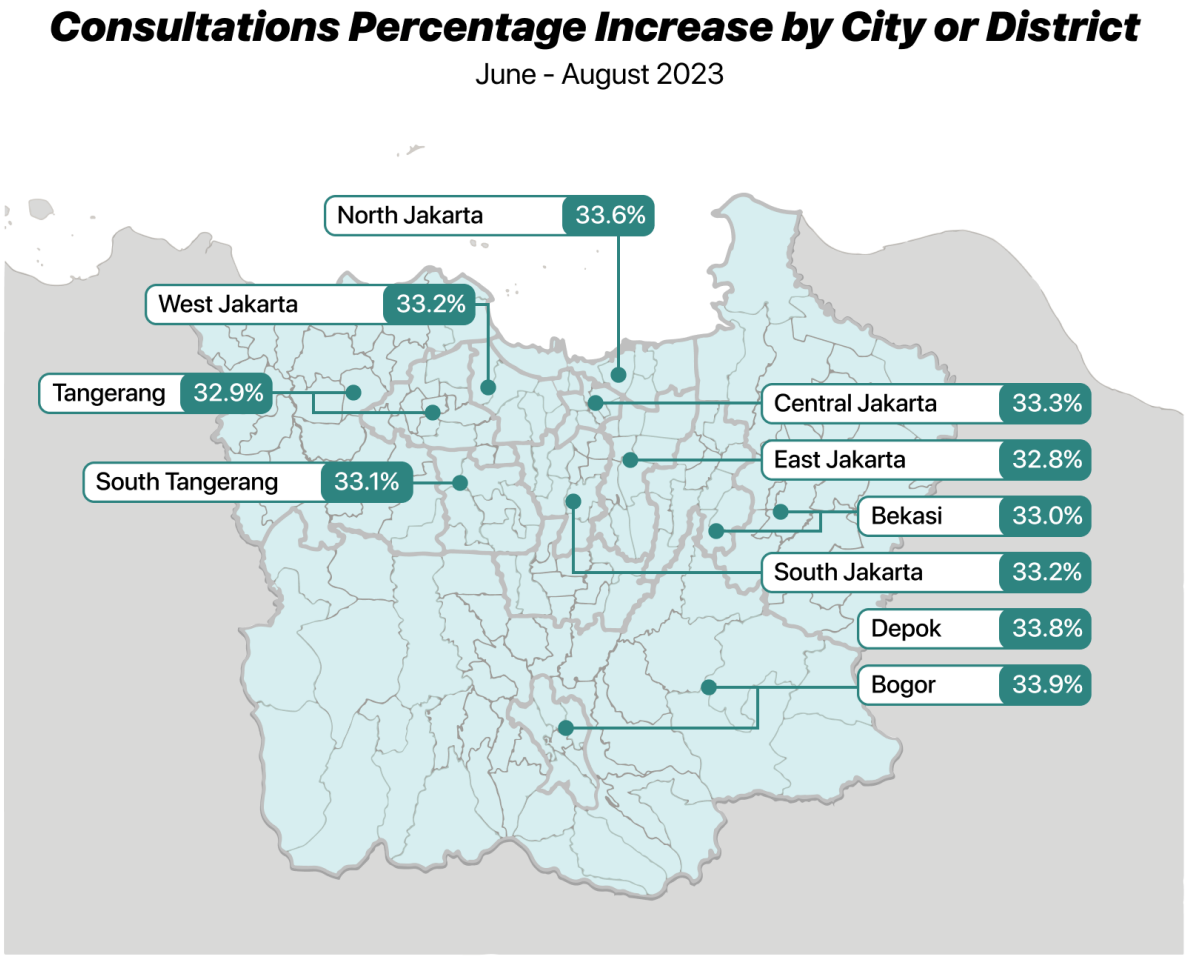


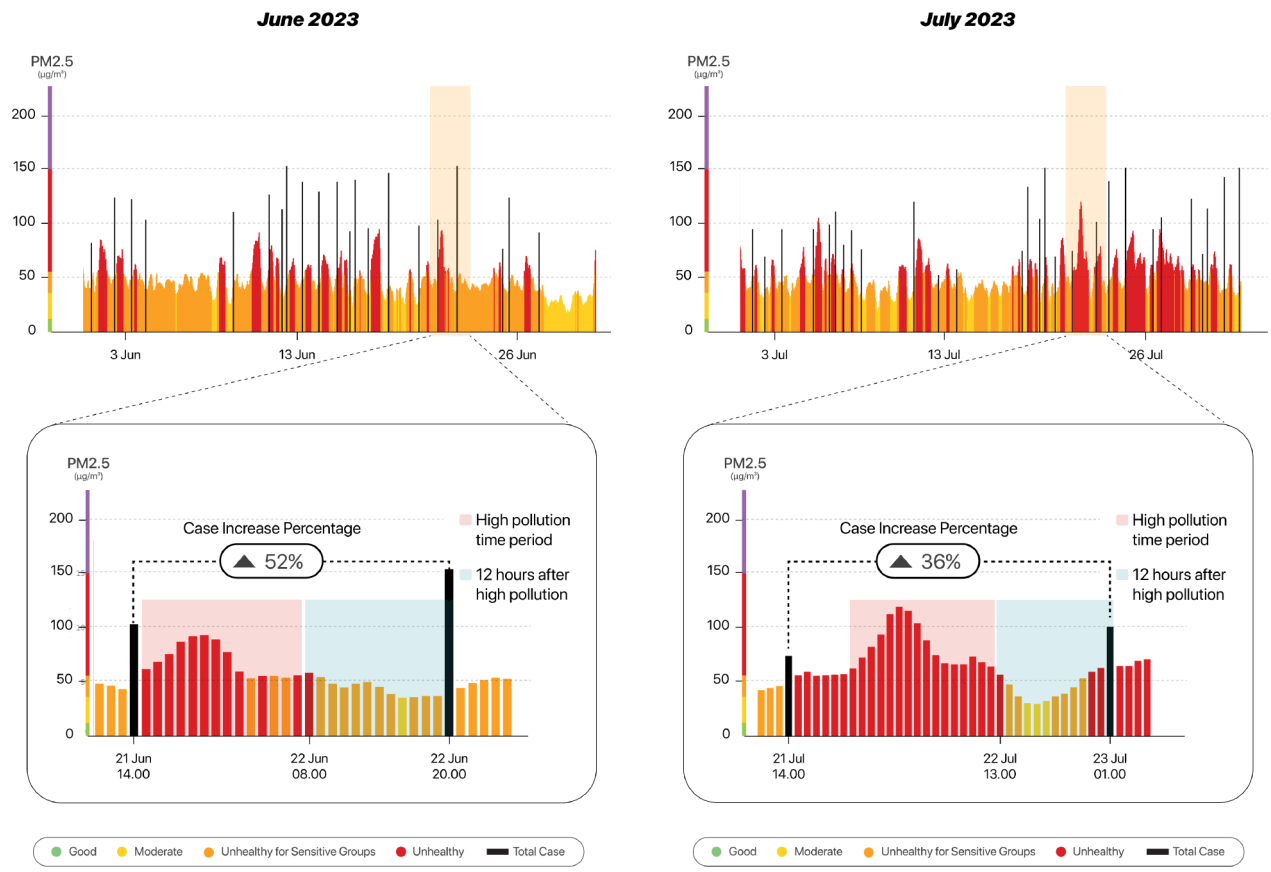
Image 6.
Distribution map of the percentage increase in respiratory teleconsultations for every 10 µg/m³ increase in PM2.5 in various areas of Jakarta Greater Area during June, July, and August 2023.

In the city coverage, for every 10 µg/m³ increase in PM2.5 above the baseline (31 µg/m³), it increased the highest respiratory complaints in the Bogor area by 33.9%, followed by Depok at 33.8%, and North Jakarta at 33.6% during June, July, and August 2023.

Finding 3

PM2.5 concentrations ≥ 55 µg/m³ pose a risk of causing respiratory complaints within 12 hours

Based on specific data from June to August 2023, this study found the highest trend of respiratory complaints within a 12-hour period following an increase in PM2.5 with concentrations exceeding 55 µg/m³.



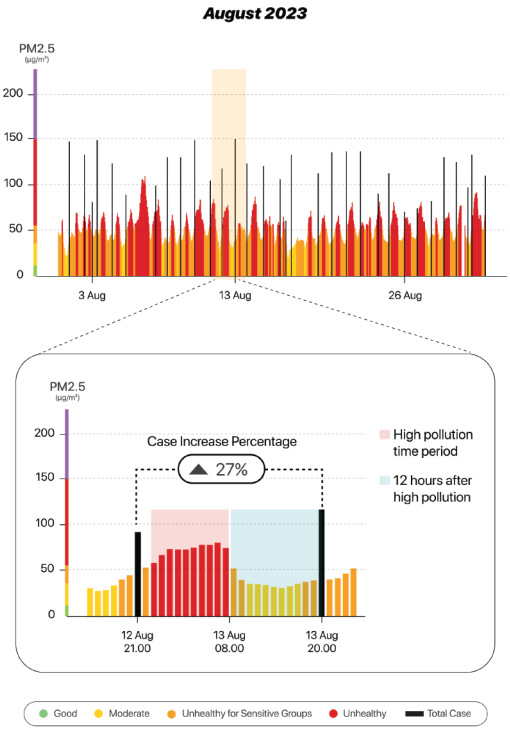


Image 7.
The relationship between peak PM2.5 concentrations a bove 55 µg/m³ and the average respiratory complaints on Halodoc within a 12-hour timeframe.

The more frequent the occurrence of PM2.5 concentrations above 55 µg/m³, the higher the frequency of increased respiratory complaints, as seen in August 2023 (Figure 7). This indicates that PM2.5 concentrations exceeding 55 µg/m³ have the potential to trigger respiratory complaints within a 12-hour timeframe.

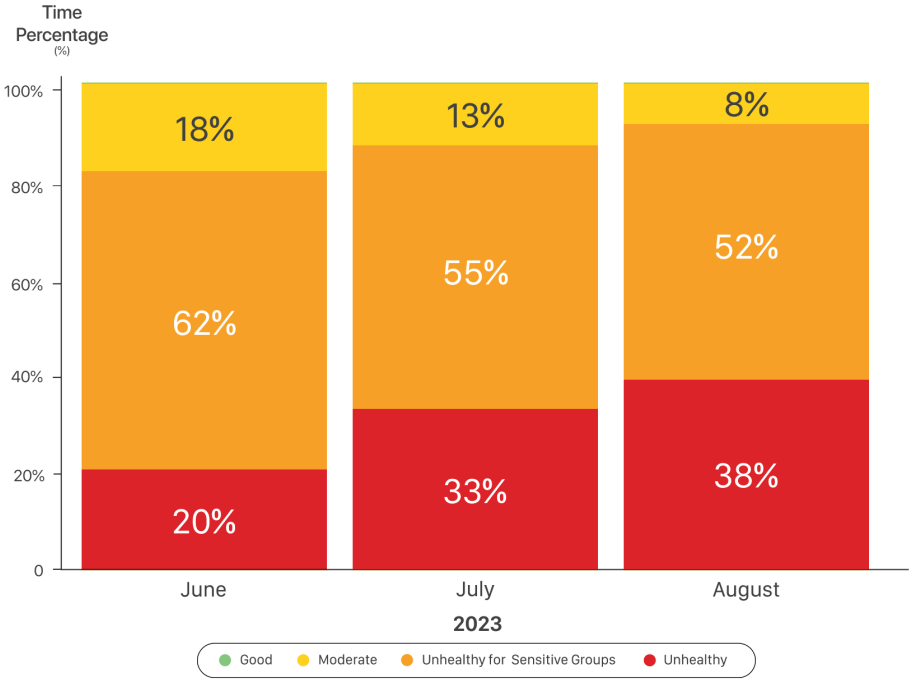


Image 8.
Percentage of hours with PM2.5 in the Moderate (yellow), Unhealthy for Sensitive Groups (orange), and Unhealthy (red) categories in June, July, and August 2023.

Finding 4

Bronchitis and Asthma complaint increases up to 5 times higher within 48 hours.

PM2.5 pollution can trigger various respiratory diseases, and the severity of symptoms can vary among individuals based on factors other than pollution. In this study, several respiratory diseases were focused on, including rhinitis, bronchitis, influenza, asthma, and sinusitis.

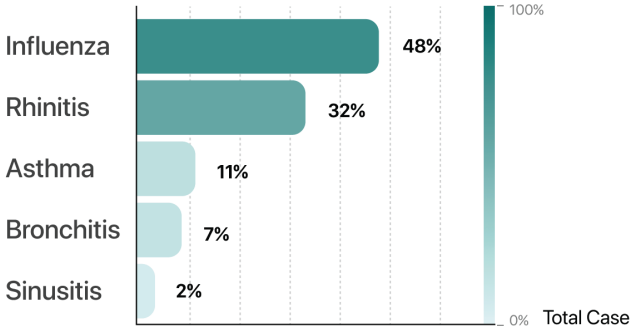


Image 9.
Overview of the number of respiratory disease cases during June - August 2023 in Jakarta Greater Area for influenza, rhinitis, asthma, bronchitis, and sinusitis.

Based on the graph below (Figure 10), the data shows the percentage trend of respiratory complaints in relation to PM2.5 pollution over a 3-48 hours period. PM2.5 concentration per hour is compared with the average teleconsultations on the Halodoc platform per hour (related to respiratory issues).

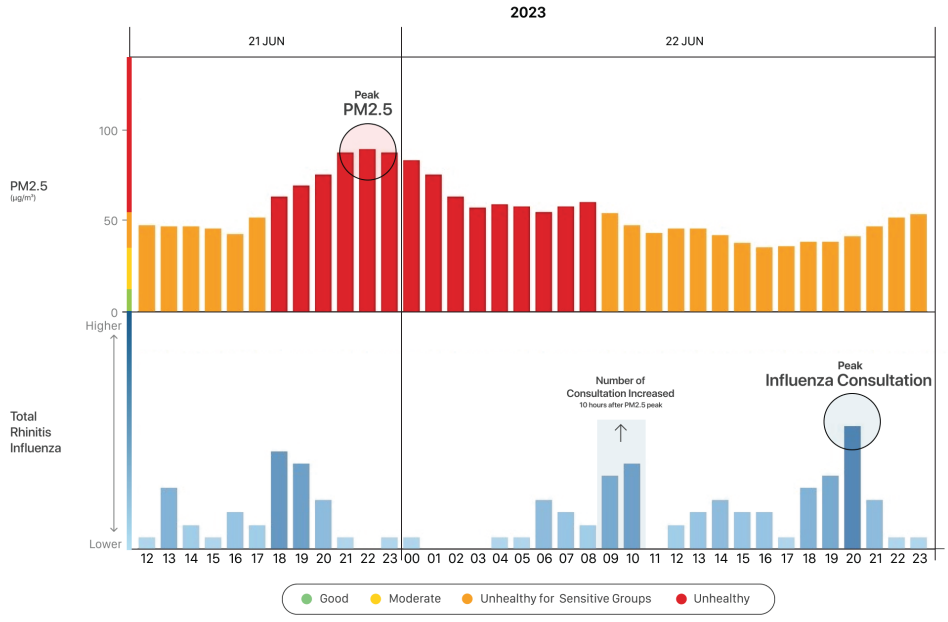


Image 10.
Example graph illustrating the calculation of the percentage trend of Influenza disease complaints in relation to PM2.5 over a specific time period.

Disease	Increase in Cases	Time Window (Hours)
Rhinitis	**2 - 4 X**	**12 - 15**
Bronkitis	**1 - 5 X**	**15 - 48**
Influenza	**2 - 3 X**	**6 - 15**
Asma	**1 - 5 X**	**3 - 48**
Sinustis	**2 - 3 X**	**3 - 12**

Table 5.
Multiples of Increase for Each Respiratory Disease Over Specific Time Windows for the Entire Months of June, July, and August 2023.

On average, all types of respiratory diseases experienced a 17% increase in cases within 1 - 2 days after high pollution period. Sinusitis and Asthma were the quickest to see an increase in cases (3 - 48 hours), with Asthma and Bronchitis experiencing the highest increase in cases (5 times).

Finding 5.

Sensitive groups have the highest risk of respiratory problems, up to 48% during the period of June to August.

PM2.5 pollution from June to August 2023 consistently fell into the Unhealthy category (Unhealthy for Sensitive Groups and Unhealthy). During this period, it was found that respiratory complaints increased with the rise in PM2.5 pollution.

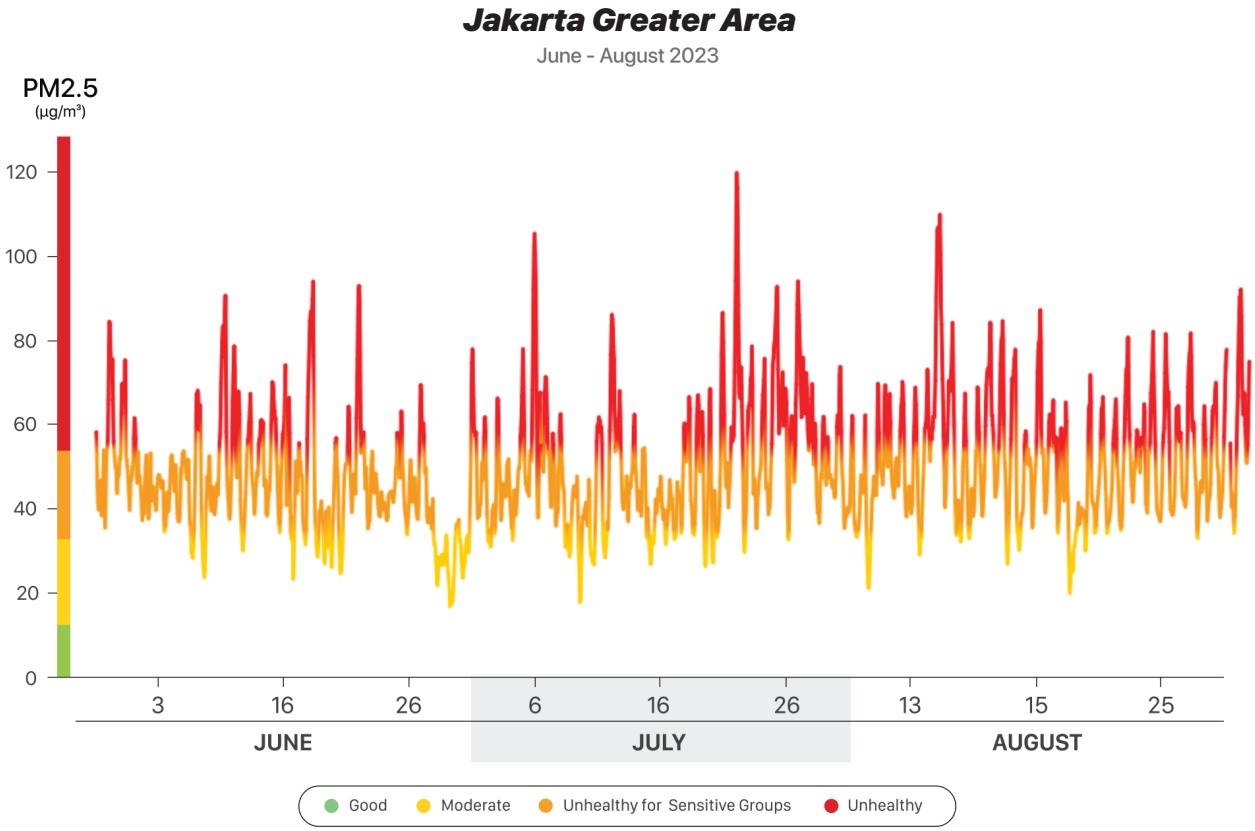
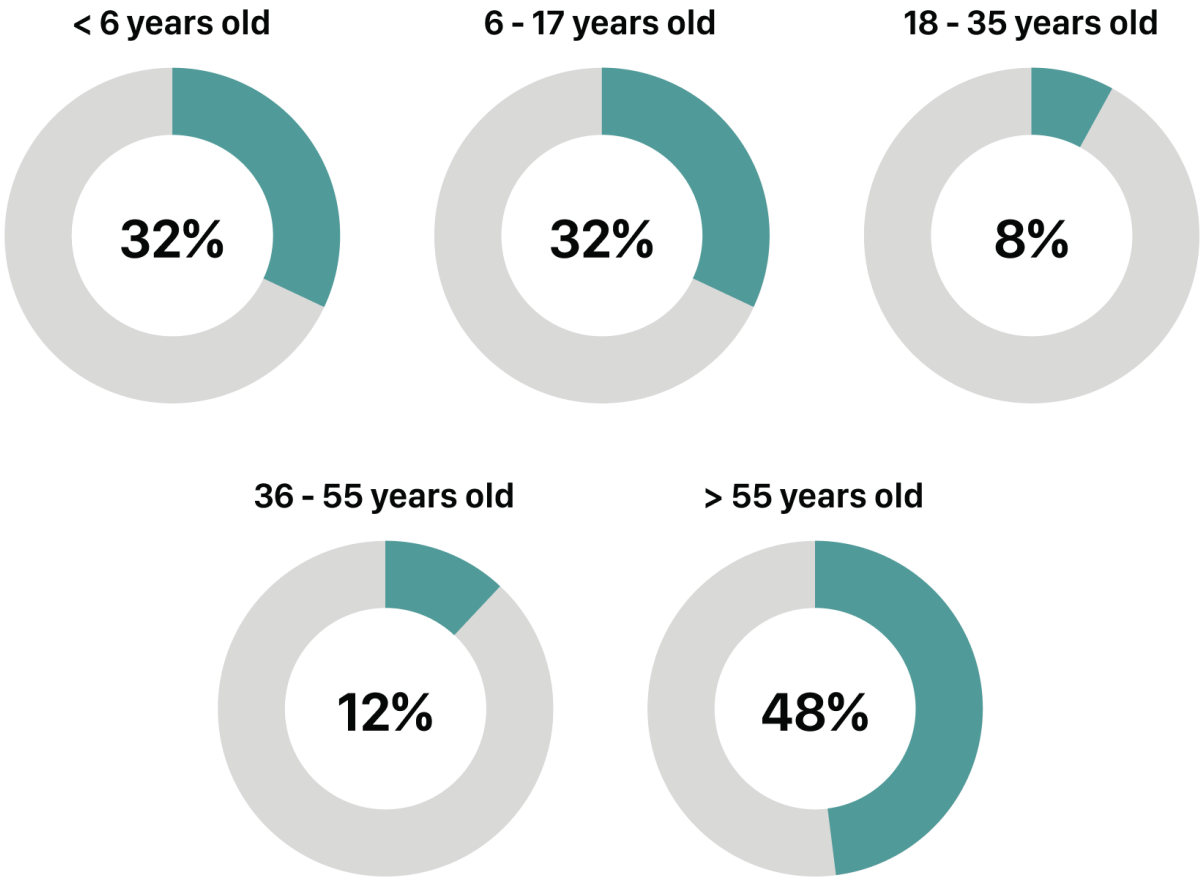


Image 11.
Hourly PM2.5 Data for Jakarta Greater Area Region from June to August 2023

Sensitive groups are those vulnerable to respiratory complaints with the highest complaint percentage. The highest increase in cases occurred in the elderly group aged over 55, at 48%. Meanwhile, the age group of 0-17 years experienced an increase of 32% from June to August 2023.

Increase of Respiratory Disease Cases Percentage Based on Age Group



Gambar 12.
Percentage increase in respiratory disease cases for each age group in Jakarta greater area from June to August 2023

Overall, as PM2.5 pollution increased, as shown in the data (Figure 8 and Figure 11), there was an increase in respiratory complaints across all age groups from June to August 2023. The sensitive groups (children and the elderly) experienced the highest increase in cases compared to the productive age group. However, the type of respiratory disease experienced by each age group varies depending on several factors, such as immunity, behavior, and the environment. It should be noted that in general, these conditions can also be influenced by underlying medical conditions. Additionally, for the children and elderly age groups, there may be a bias as teleconsultations on the Halodoc application could be represented by their parents or family members.

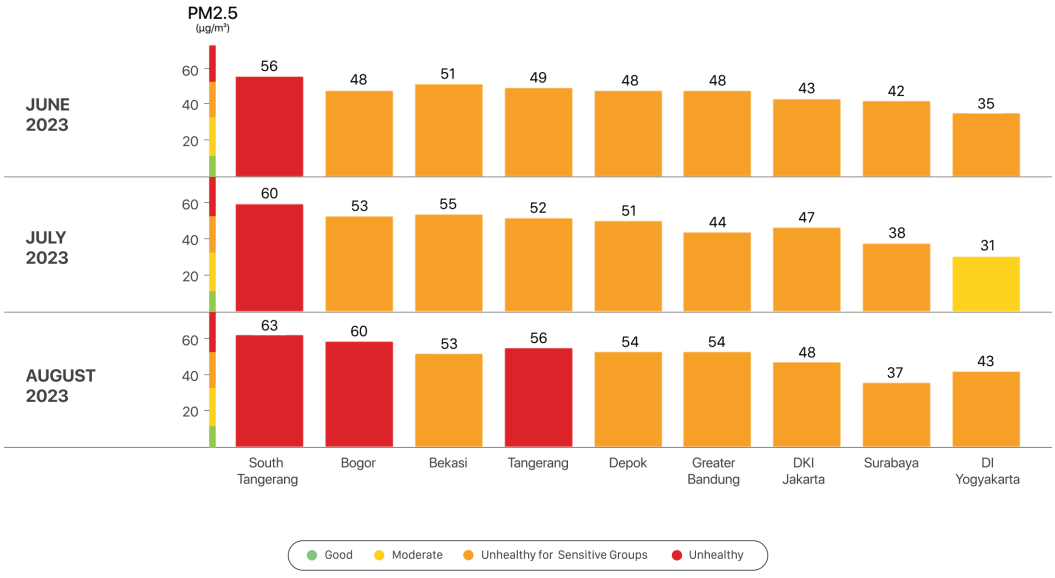
6

Conclusion

Several key points obtained from this study are as follows:

1 Air pollution is a serious issue

Many areas in Indonesia have PM2.5 concentrations exceeding the annual World Health Organization limit of 5 µg/m³ and the annual Ambient Air Quality Standard of 15 µg/m³ in the Nafas network. Generally, the dry season, which includes June, July, and August, has the highest monthly concentrations compared to other months.
Air pollution is not just a problem in Jakarta Greater Area; other regions also need attention.



2 The Nafas and Halodoc studies show that PM2.5 poses a risk of increased respiratory complaints.

This study found that there was an average increase in respiratory disease complaints of up to 34% when PM2.5 increased by 10 µg/m³. Based on the data analysis, all respiratory diseases studied in this study experienced an increase in cases within 3-48 hours after the peak concentration of PM2.5 exceeded 55 µg/m³.

3 Sensitive groups are more vulnerable to respiratory issues.

This study found a trend of the highest increase in cases occurring in the elderly group aged over 55, at 48%. Meanwhile, the age group of 0-17 experienced an increase of 32% from June to August 2023 when PM2.5 pollution during this period consistently fell into the Unhealthy category (Unhealthy for Sensitive Groups and Unhealthy).

4 The importance of reducing pollution sources and air pollution exposure.

From this study, it can be seen that the number of respiratory disease complaints may potentially increase within short term period of PM2.5 increment. To maintain a healthy body, preventing problems or triggers is the first and foremost step to take. Environmental factors, including air pollution, are crucial to pay attention to. Efforts are needed to reduce daily sources and exposure to air pollution due to its significant health impacts.

5 Air pollution data from low-cost sensors can be used for health studies.

Combining air pollution (PM2.5) data from low-cost sensors with health data such as the number of disease cases in this study shows that similar studies can be conducted. In order to measure acceptable risks in maintaining public health, many local studies are needed to enrich public insights and understanding of the risks they may face.

7

Quick Steps to Protect Yourself in the Midst of Air Pollution

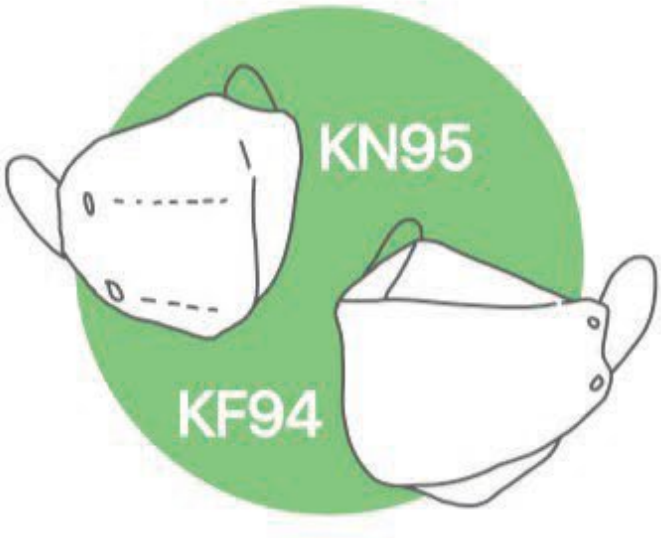
1 Apply the SEHAT protocol

To maintain good health condition in polluted areas, there are several things you can do, including following the SEHAT protocol:

- **S** Stay updated to current air quality in the Nafas app
- **E** Effects of pollution are real, stay home during bad air episodes
- **H** Have your mask on when you have to go outside
- **A** A vitamin and regular exercise are needed to boost immunity
- **T** Teleconsult Halodoc if you have respiratory problems

2 Proper use of mask:

The use of masks is highly recommended when engaging in outdoor activities. Choose masks with KF94 or KN95 standards that can filter PM2.5 particles.



3 Nasal Irrigation

In addition to wearing masks when outdoors, you can also perform nasal irrigation to clean the nasal passages with a saline solution such as Sodium Chloride (NaCl) solution.

The steps for nasal irrigation can be seen in the following video https://bit.ly/HalodocIrigasiHidungand follow the steps shown in the attached graphic.

Step 1

Ensure that your hands are both clean and dry.

Step 2

Have small and medium-sized water containers, a 10 cc syringe, and NaCl solution ready. Pour the NaCl solution into the small container, then use the syringe to draw the liquid.

Step 3

Get into a comfortable position. Tilt your head (about 45 degrees) to the right when cleaning the left nasal passage and vice versa.

Step 4

Gently open your mouth and then hold your breath.

Step 5

Insert the syringe's tip into the left nostril and gently press until the NaCl solution is depleted. Remove the liquid from both nostrils and wipe your nose with a tissue.

Step 6

Repeat the process for the other nostril and can be done multiple times until your breathing feels clearer and fresher.

Step 7

Clear any residual liquid from your nose and wash your hands with soap after completing the nasal wash.

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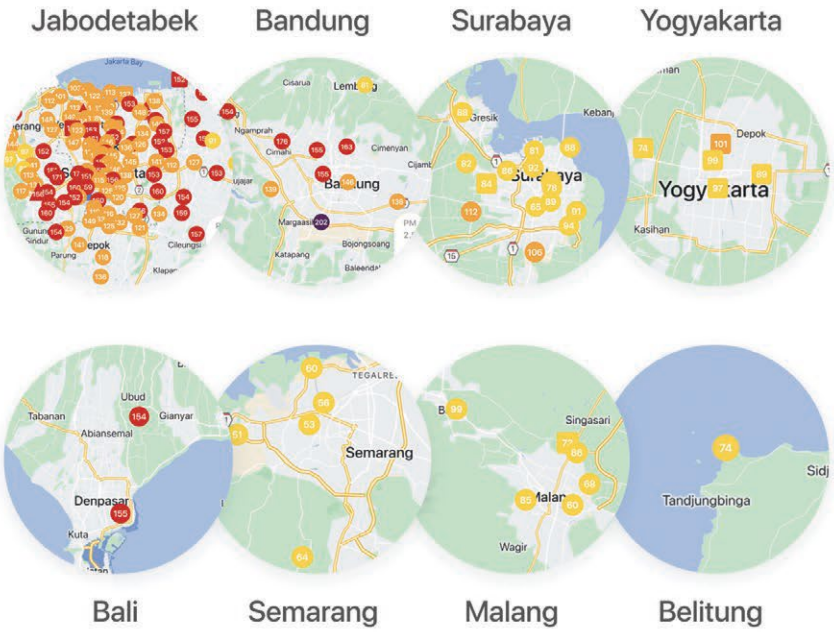
About nafas

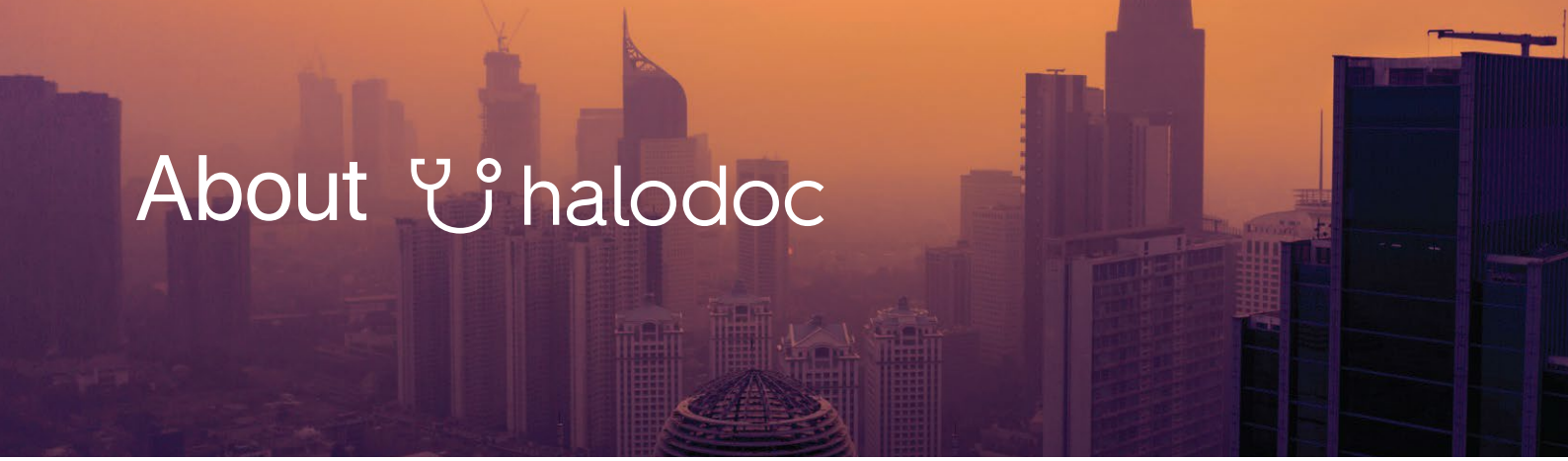
Nafas is a technology-driven healthcare company on a mission to support the well-being of residents in polluted urban areas by offering real-time hyperlocal air pollution data access to the public.

Nafas was founded in 2020 by Nathan Roestandy and Piotr Jakubowski. The Nafas sensor network now spans over 180 sensors across various regions in Indonesia and continues to expand. Observation points are not limited to Jakarta greater area; they also exist in other major cities such as Bandung, Surabaya, Semarang, Yogyakarta, Malang, as well as the Bali and Belitung islands.



Nafas is dedicated to raising public awareness about the air they breathe into their lungs and bodies while working to mitigate exposure to hazardous air pollution.

We are open to collaborations and studies related to air pollution, particularly its impact on health. For more information, you can contact us at info@nafas.co.id or through Nafas' social media channels (@nafasidn).



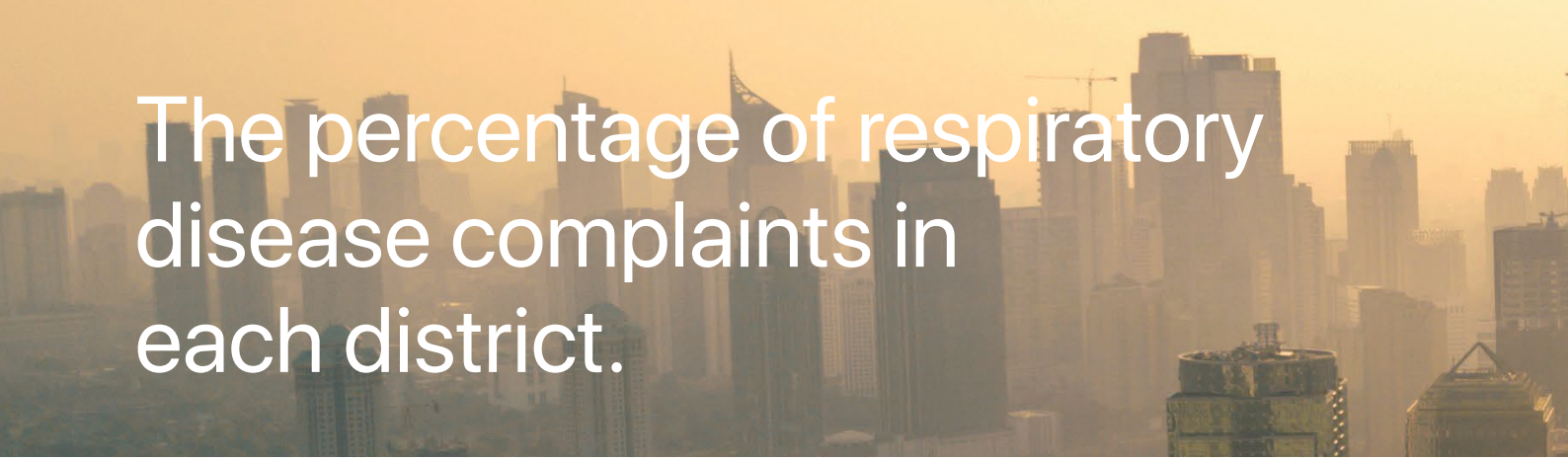
About halodoc

Halodoc stands as a pioneer in the realm of digital healthcare services, with a profound mission to streamline access to healthcare. This mission centers around addressing the pain points that communities face in their quest for healthcare that is easy, safe, convenient, and affordable.

Since 2016, Halodoc has gone beyond its role in enhancing public health literacy through accessible Health Communication, Information, and Education (HCIE). The digital healthcare ecosystem of Halodoc has continually expanded, introducing a range of services that ease the burdens of the public. These services include **Home Lab,** which offers preventive healthcare services allowing users to undergo health tests safely and privately from the comfort of their homes. There's also **Asuransiku,** designed to simplify users' access to cashless and seamless outpatient benefits. Moreover, **Chat with Doctor** empowers users to interact with over 20,000 licensed healthcare professionals via chat, video calls, and voice calls. Lastly, the **Health Store service** enables users to conveniently access healthcare products from a network of over 4,900 trusted partner pharmacies.

Halodoc is a telehealth platform in Indonesia that has had a positive impact on the healthcare sector in the country and has been designated as "supervised" in the Ministry of Health of the Republic of Indonesia's Regulatory Sandbox program. This reflects the strong commitment and partnership between Halodoc and the Ministry of Health of the Republic of Indonesia, which aims to ensure the participative oversight for the protection of Digital Healthcare Innovation (DHI) providers and the safety of users and healthcare professionals as digital innovation partners. Over time, Halodoc has received national and international recognition, including being the only Southeast Asian healthtech startup listed in CB Insights' Digital Health 150 for 2019-2020 and receiving the PPKM Award 2023 from the Indonesian government.

The Halodoc application is available for download on both **iOS** and **Android** platforms.



The percentage of respiratory disease complaints in each district.

Region	Subdistrict	June	July	August
Bekasi	Tarumajaya	34.4%	33.7%	32.0%
Bekasi	Tambun Selatan	33.8%	32.2%	32.0%
Bekasi	Setu	33.7%	32.7%	31.8%
Bekasi	Pondok Gede	33.7%	32.1%	31.9%
Bekasi	Medan Satria	34.9%	35.0%	34.0%
Bekasi	Cikarang Selatan	34.3%	33.7%	32.9%
Bekasi	Bekasi Utara	34.9%	33.2%	32.5%
Bekasi	Bekasi Selatan	33.4%	32.1%	32.2%
Bogor	Tanah Sereal	35.4%	34.2%	33.2%
Bogor	Sukaraja	41.0%	38.8%	32.0%
Bogor	Gunung Sindur	36.9%	33.3%	33.0%
Bogor	Gunung Putri	34.0%	31.6%	31.7%
Bogor	Ciomas	35.6%	33.8%	32.9%
Bogor	Cileungsi	33.7%	33.1%	33.1%
Bogor	Cibinong	38.1%	38.0%	32.0%
Bogor	Babakan Madang	39.1%	37.3%	32.7%
Depok	Tapos	35.5%	33.7%	32.4%
Depok	Sukmajaya	35.8%	33.5%	32.0%
Depok	Sawangan	34.6%	32.3%	32.3%
Depok	Limo	35.8%	34.2%	34.0%
Depok	Cipayung	36.4%	34.2%	31.7%
Depok	Cinere	34.2%	32.8%	32.4%
Depok	Cimanggis	35.6%	32.9%	32.3%
Depok	Bojongsari	36.1%	33.1%	32.0%
Depok	Beji	35.1%	33.8%	33.0%
West Jakarta	Tambora	35.6%	33.6%	31.9%
West Jakarta	Taman Sari	35.8%	36.0%	33.2%
West Jakarta	Palmerah	33.0%	32.1%	32.0%
West Jakarta	Kembangan	33.8%	32.3%	31.7%
West Jakarta	Kebon Jeruk	34.8%	33.2%	32.4%
West Jakarta	Kalideres	33.0%	31.6%	32.4%
West Jakarta	Grogol Petamburan	34.9%	32.6%	32.2%
West Jakarta	Cengkareng	34.9%	33.2%	32.5%
Central Jakarta	Tanah Abang	34.5%	32.8%	32.2%
Central Jakarta	Menteng	34.7%	32.1%	32.2%
Central Jakarta	Kemayoran	35.5%	32.6%	31.8%
South Jakarta	Tebet	34.3%	33.2%	31.8%
South Jakarta	Pesanggrahan	33.5%	32.6%	31.9%
South Jakarta	Pasar Minggu	35.0%	31.8%	32.3%

Region	Subdistrict	June	July	August
South Jakarta	Mampang Prapatan	34.2%	34.3%	32.9%
South Jakarta	Kebayoran Lama	34.1%	31.8%	32.0%
South Jakarta	Kebayoran Baru	38.2%	35.4%	34.5%
South Jakarta	Jagakarsa	34.7%	33.3%	32.1%
South Jakarta	Cilandak	35.0%	35.0%	34.6%
East Jakarta	Pulo Gadung	35.2%	31.8%	32.0%
East Jakarta	Makasar	33.7%	32.7%	32.1%
East Jakarta	Kramat Jati	34.7%	33.0%	33.1%
East Jakarta	Jatinegara	35.2%	33.0%	31.9%
East Jakarta	Duren Sawit	33.7%	33.4%	32.2%
East Jakarta	Ciracas	36.9%	33.0%	33.1%
East Jakarta	Cipayung	34.4%	32.8%	31.6%
East Jakarta	Cakung	33.6%	32.6%	31.9%
North Jakarta	Tanjung Priok	34.4%	33.0%	31.8%
North Jakarta	Penjaringan	36.7%	34.6%	34.0%
North Jakarta	Pademangan	35.3%	33.2%	32.5%
North Jakarta	Koja	35.5%	35.7%	33.0%
North Jakarta	Kelapa Gading	34.0%	33.1%	31.8%
North Jakarta	Cilincing	36.0%	35.3%	34.1%
Tangerang	Tangerang	32.0%	33.0%	32.5%
Tangerang	Periuk	35.1%	33.8%	32.7%
Tangerang	Panongan	35.0%	34.2%	32.4%
Tangerang	Neglasari	33.7%	33.2%	32.4%
Tangerang	Larangan	32.8%	32.6%	32.5%
Tangerang	Kelapa Dua	35.4%	36.1%	33.2%
Tangerang	Cisauk	35.2%	33.2%	31.8%
Tangerang	Cipondoh	34.1%	33.1%	32.4%
Tangerang	Ciledug	34.6%	34.2%	30.8%
South Tangerang	Setu	34.5%	32.4%	32.7%
South Tangerang	Serpong Utara	35.1%	33.4%	32.4%
South Tangerang	Serpong	34.2%	30.6%	34.7%
South Tangerang	Pamulang	34.0%	33.6%	32.2%
South Tangerang	Ciputat Timur	33.8%	33.0%	32.1%
South Tangerang	Ciputat	34.3%	32.8%	31.6%

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