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Monitoring CO Pollutants in Ambient Air Quality in Public Spaces of Padang City

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ABSTRACT

Air pollution in urban areas is a multidimensional threat with systemic impacts on the environment and public health. Carbon monoxide (CO), as a toxic gaseous pollutant from the incomplete combustion of fossil fuels, is the focus of this study which evaluates the spatial-temporal distribution of CO concentrations in public spaces of Padang City during 2020-2024. Using a Systematic Literature Review (SLR) approach and longitudinal environmental data from four strategic points, a significant decrease in CO levels was found from 14,596 μg/m^3 (2020) to 286 μg/m^3 (2024). Peak concentrations occurred in the dry season, reinforcing the influence of meteorological variables. These results emphasize the importance of real-time digital monitoring systems, multi-sectoral emission policy reformulation, and integration of green open spaces in urban planning. In the future, monitoring should be expanded to other pollutants, congestion locations, and linked to public health early warning systems to support urban sustainability and resilience.

Keywords
Ambient Air Quality, Carbon Monoxide (CO) Monitoring, Urban Air Pollution, Systematic Literature Review (SLR), Public Health and Air Quality

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INTRODUCTION

Air pollution is a major environmental issue in urban areas, negatively impacting people's health and quality of life [1]. Of the various sectors that have the potential to pollute the air, the transportation sector plays a very large role compared to other sectors [2]. Air pollution is a serious problem in the context of environmental pollution. Each year, air pollution, both from outdoor and indoor sources, causes about 7 million deaths, a figure that is three times higher than deaths from diseases such as malaria, tuberculosis and AIDS. In addition, air pollution is the leading cause of death from heart disease (about 25%), stroke (about 24%), obstructive pulmonary disease (about 43%), and lung cancer (about 29%). The increase in the number of motorized vehicles has contributed to the increase in air pollution. Pollutant gases such as carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NO), sulfur dioxide (SO), and lead (Pb) produced by motor vehicles are the main causes of air pollution [3]. Large cities contribute a lot to motor vehicle exhaust gases as a source of air pollution, reaching 60-70%.

Transportation activities that involve the use of fossil fuel vehicles will produce air pollution in the form of gases and particulates. Transportation today still mostly uses fossil fuels as the main fuel, and the increasing use of oil-fueled vehicles such as cars, motorcycles, results in increasing levels of air pollution caused by exhaust emissions [4]. The air we breathe every day is made up of 21% oxygen and 78% nitrogen, with the rest consisting of a number of rare gases. Air pollution causes some gases in the atmosphere to be at higher than normal conditions, and can be very harmful to human health [5]. Gasoline engines are the most effective fuel in economic growth such as in transportation. But emissions from gasoline engines are harmful to the environment and human health. Currently, emissions and pollutants such as carbon monoxide (CO), oxides of nitrogen (NOX), hydrocarbons (HC), and particulates (PM) are present in engines and can erode the ozone layer in the atmosphere [6].

Vehicle volume as a source of emissions is directly proportional to CO concentration in the air. In addition, high concentrations of Pb are also strongly correlated with changes in vehicle volume [7]. Globally, nearly 99% of the world's population breathes air with high levels of pollutants, making outdoor air exposure the largest environmental risk factor for premature death and the second leading cause of death from non-communicable diseases [8].

Ambient (outdoor) air pollution in urban and rural areas is estimated to cause 6.7 million premature deaths worldwide in 2019. These deaths are caused by exposure to fine particulate matter that causes diseases of the cardiovascular system and respiratory system, and increases the risk of cancer [9]. In 2019, it was found that 37% of premature deaths related to outdoor air pollution were caused by ischemic heart disease and stroke, 18% were caused by chronic obstructive pulmonary disease, 23% were caused by respiratory infections, and 11% of deaths were caused by respiratory cancer [9]. This was seen in the previous year's data in South and East Asian countries as the most polluted regions globally.

Every year, Padang city experiences an increase in the number of vehicles due to its growing population. This is directly proportional to the increasing number of vehicles which can be a contributing factor to ambient air quality pollution by emissions from vehicle fuel combustion. According to the Regulation of the Minister of Environment and Forestry (LHK) of the Republic of Indonesia on the quality standards of engine emissions with internal combustion, provisions, the definition of air pollution is the entry or inclusion of living things, substances, energy and or other components into the air or changes in air order due to human activities or by natural processes, so that the air quality decreases to a certain level and the air will become less or can no longer function according to its use. Along with the increasing number of pollutant vehicle emissions, negative impacts in the form of increased risk of environmental pollution and health problems are inevitable [10].

According to Government Regulation of the Republic of Indonesia Number 14 of 2020 concerning the Air Pollution Standard Index (ISPU), there are parameters contained in clean air, these parameters can be seen in Table 1 below.

Table 1. ISPU Parameter Concentration Value Conversion [11].

ISPU	24 Hours particulate matter (PM10) µg/m3	24 Hours particulate matter (PM2.5) µg/m3	24 Hours sulfur dioxide (SO2) µg/m3	24 Hours carbon monoxide (CO) µg/m3	24 Hours ozone (O3) µg/m3	24 hours nitrogen dioxide (NO2) µg/m3	24 Hours hydrocarbon (HC) µg/m3
0-50	50	15,5	52	4000	120	80	45

ISPU	24 Hours particulate matter (PM10) µg/m3	24 Hours particulate matter (PM2.5) µg/m3	24 Hours sulfur dioxide (SO2) µg/m3	24 Hours carbon monoxide (CO) µg/m3	24 Hours ozone (O3) µg/m3	24 hours nitrogen dioxide (NO2) µg/m3	24 Hours hydrocarbon (HC) µg/m3
51-100	150	55,4	180	8000	235	200	100
101-200	350	150,4	400	15000	400	1130	215
201-300	420	250,4	800	30000	800	2260	432
>300	500	500	1200	45000	1000	3000	648

In the Table 1, there are 5 Air Pollution Standard Indices categorized in determining ambient air quality at a location. The following explanation of numbers based on color can be seen in Table 2.

Table 2. ISPU Categories and Coloring.

Category	Colour	Number Range
Good		1-50
Medium		51-100
Unhealthy		101-200
Very Unhealthy		201-300
Dangerous		>300

From the description above, it is necessary to identify the concentration of CO gas around the Padang city area so that it can be used as a basis for the Government regarding the management of CO gas in the environment can be handled. The purpose of this research is to assess the feasibility of ambient air quality standards in Padang city on CO concentration based on Systematic Literature Review (SLR) analysis.

METHOD

This research was prepared using the Systematic Literature Review (SLR) method, and presents data records in the form of Carbon Monoxide gas pollutant measurement data obtained from the Padang City Statistics Center. Systematic Literature Review is a term that refers to a particular research methodology used to collect and evaluate research relevant to a particular topic of focus (SLR) [12]. Measured at four locations that represent places where people do outdoor activities, including Imam Bonjol Padang Green Open Space (RTH), in front of SMA 1 Padang, Balai Kota on the Padang bypass road, and Pasar Lubuk Buaya Padang.

Research Objectives A Systematic Literature Review (SLR) is conducted for a variety of purposes, including identifying, reviewing, evaluating, and interpreting all existing research in a topic area of phenomena of interest, with specific relevant research questions [12-14]. A

Systematic Literature Review (SLR) is also often required to define a research agenda, as part of a dissertation or thesis, and serves as a complementary element to a research grant application [15].

RESULT AND DISCUSSION

Results

This study, consisting of 4 sampling locations, is presented in the analysis of monitoring CO pollutants in Ambient air quality in public spaces. This data table provides a clear picture of CO pollutant concentrations for the 4 locations, years, and periods of pollutant surveys conducted and can be the basis for decision making. Measurement of ambient air quality standards is an activity carried out by the Environmental Agency in each Regency / City and Province, ambient air quality / quality measurements are carried out twice a year in the January-February and July-August periods), the selection of measurement times thus represents the two seasons in Indonesia, where the January-February period represents the summer and July-August represents the rainy season. The following is a recap of the data from 2020 to 2024. For more information, please see Table 3.

Table 3. CO concentration parameter.

Year	Period	location			
		RTH Imam Bonjol	SMA 1 Padang	Balai Kota	Pasar Lubuk Buaya
2020	I	6.506	8.431	12.123	14.596
	II	7.047	6.489	7.464	7.860
2021	I	4.652	5.293	3.940	6.920
	II	3.954	3.516	3.989	3.897
2022	I	3.093	2.520	2.405	3.322
	II	2.062	1.146	1.260	2.291
2023	I	1.260	4.811	1.374	2.062
	II	1.031	1.145	1.833	1.260
2024	I	2.635	1.031	1.604	1.489
	II	3.589	286	3.322	1.146

The CO pollutant concentration condition at the time of sampling is the parameter level or condition of CO concentration in the ambient air of Padang city. Measurements of CO concentration conditions were carried out at 4 location points including RTH Iman Bonjol, in front of SMA 1 Padang, Balai Kota, and Pasar Lubuk Buaya based on the last 5 years of data.

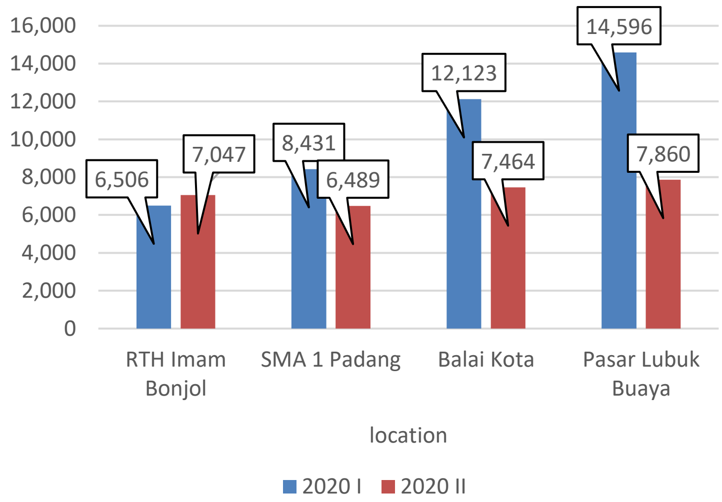

Figure 1. CO Measurement Results Chart 2020

Based on Figure 1, CO concentrations in 2020 for period 1 show a range of 6,506-14,596 μg/m^3 with the highest value at Pasar Lubuk Buaya and the lowest at RTH Iman Bonjol, while period 2 shows a narrowing of the range to 6,489-7,860 μg/m^3 where Pasar Lubuk Buaya remains dominant as the highest point while the lowest concentration moves to the front of SMA 1 Padang.

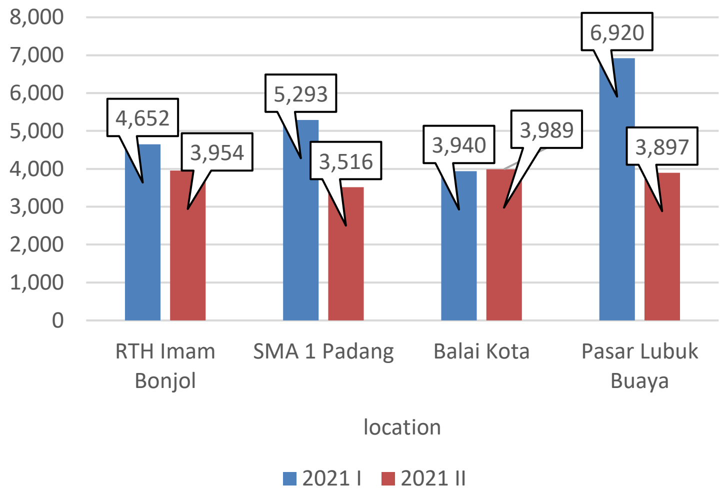

Figure 2. CO Measurement Results Chart 2021

Based on the interpretation of the data in Figure 2, the CO concentration parameter in 2021 period 1 shows significant variability in the range of 3,940-6,920 μg/m^3 with the maximum concentration detected at the Pasar Lubuk Buaya location and the minimum in the Balai Kota area, while in period 2 there is a narrowing of the concentration range to 3,516-3,989 μg/m^3 which is accompanied by a change in the spatial distribution pattern where Balai Kota has increased to the point with the highest concentration while the area in front of SMA 1 Padang recorded the lowest concentration.

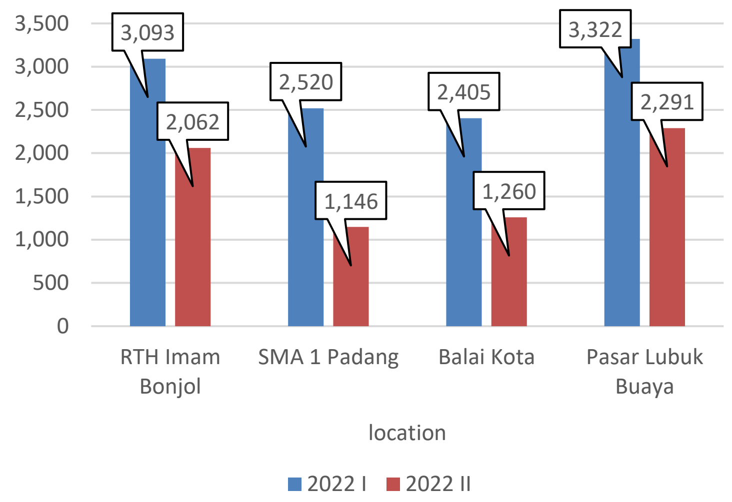

Figure 3. CO Measurement Results Chart 2022

Based on the interpretation of the data in Figure 3, the CO concentration parameter in 2022 period 1 shows a distribution in the range of 2,405-3,322 µg/m^3 with the maximum value identified at the Pasar Lubuk Buaya location and the minimum in the Balai Kota area, while in period 2 there is a decrease in the concentration range to 1,146-2,291 µg/m^3 where Pasar Lubuk Buaya maintains its position as the point with the highest concentration while the lowest concentration has moved to the area in front of SMA 1 Padang.

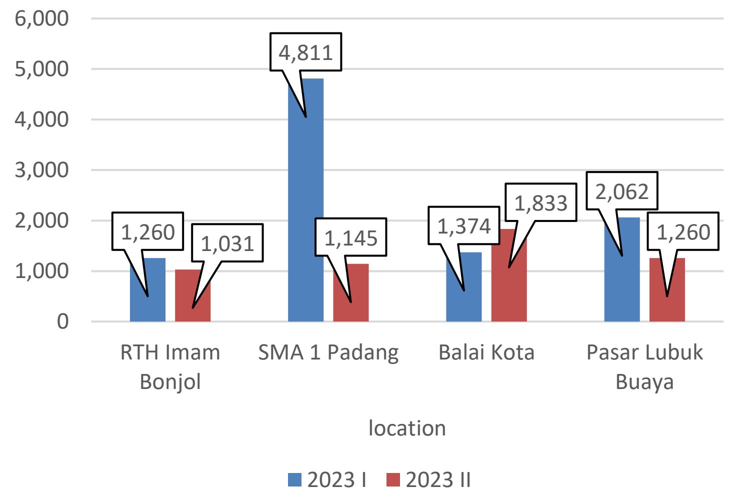

Figure 4. CO Measurement Results Chart 2023

Based on Figure 4, the CO concentration in 2023 in period 1 is in the range of 1,260-4,811 µg/m^3 with the highest value in front of SMA 1 Padang and the lowest at RTH Iman Bonjol, while period 2 shows a narrower range of 1,031-1,833 µg/m^3 with the highest concentration at Balai Kota and the lowest remaining at RTH Iman Bonjol.

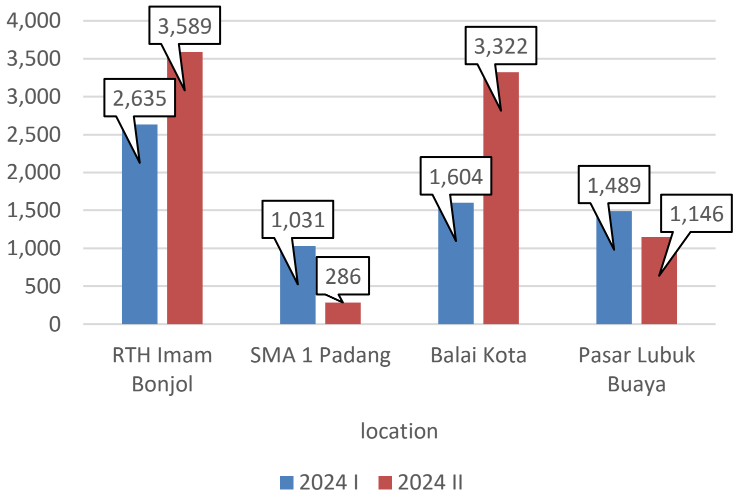

Figure 5. CO Measurement Results Chart 2024

The 2024 monitoring data, as depicted in Figure 5, shows significant fluctuations in CO concentrations, with period 1 recording a range of 1,031-2,635 μg/m^3 with RTH Imam Bonjol as the highest location, while period 2 shows more extreme variations (286-3,589 μg/m^3) with a consistent distribution pattern - RTH Imam Bonjol continues to dominate the highest concentrations, while the SMA 1 Padang area consistently records the lowest values in both measurement periods.

Looking at the monitoring data over the period 2020-2024, Pasar Lubuk Buaya consistently showed the highest CO concentrations, especially in 2020-2022, reflecting the high vehicle activity in the commercial area. In contrast, RTH Imam Bonjol generally had the lowest concentrations, demonstrating the role of green open spaces in reducing air pollutants. All locations experienced drastic decreases in CO concentrations from 2020 to subsequent periods. The highest concentration was recorded in period 1 of 2020 at Pasar Lubuk Buaya (14,596 μg/m^3), while the lowest value was recorded in 2024 in front of SMA 1 Padang (286 μg/m^3). The Balai Kota and SMA 1 Padang areas show moderate variability, with fluctuations influenced by the activity characteristics of each location.

Based on the results of a comprehensive evaluation carried out by the Environment Agency of Padang city, the 2020 monitoring data shows that CO concentrations at the Balai Kota (12,123 μg/m^3) and Pasar Lubuk Buaya (14,596 μg/m^3) locations have exceeded the standard threshold set in Government Regulation No. 22/2021 of 10,000 μg/m^3, where both locations are urban activity centers with high intensity of motor vehicle mobility and significant density of community activities. Although the downward trend looks positive, continuous monitoring is still needed to ensure air quality at all locations, especially in areas with high traffic density such as Pasar Lubuk Buaya

Discussion

Air pollution is a major environmental problem in urban areas, negatively impacting the health and quality of life of these communities [1]. Dense urban populations are potentially exposed to ambient air pollution that impacts public health [16]. The people are most exposed to ambient air quality when traveling. Air pollution is one of the leading causes of worsening respiratory diseases, Chronic obstructive pulmonary disease, ischemic heart disease, and more [17]. Motor vehicles are the largest contributor to air pollutants in Indonesia due to the rapid increase in motor vehicle use in the last ten years. Emissions from vehicles are the main cause of poor air quality in urban areas.

Carbon monoxide (CO) is a colorless, odorless and tasteless gas with a small amount in the air around 0.1 ppm which is in the atmospheric layer, therefore the environment polluted by carbon monoxide (CO) gas cannot be seen by the eye [18]. This gas comes from the incomplete combustion of fossil fuels, such as coal, natural gas, gasoline, diesel, wood and charcoal. CO can also come from the incomplete combustion of garbage, charcoal, wood and other fuels. This pollutant has reactive chemical properties and is highly flammable [19]. Referring to the World Health Organization, the composition of clean air can be seen in Table 4.

Table 4. Clean Air Composition [8].

No	Parameters	Clean Air
1	Particle Material	0,01 – 0,02 mg / $m3$
2	SO2	0,003 – 0,02 PPM
3	CO	0,1 – 0,99 PPM
4	NOx	0,003 – 0,02 PPM
5	CO2	310 – 330 PPM
6	Hydrocarbons	0,1 – 0,99 PPM

Any substance that is not part of the normal air composition is called a pollutant [15]. Emissions of Nitrogen Oxides (NOx), Carbon Monoxide (CO), and volatile organic compounds from vehicles are recognized as major precursors of ozone and secondary organic aerosols in metropolitan areas. Traffic is still and will remain the largest single source of NOx pollution [20]. Air quality in urban areas is gradually leading to violations of ambient air safety limits [21]. Carbon monoxide, referred to as CO a chemical compound consisting of one carbon atom (C) and one oxygen atom (O) bonded together. This gas is primarily produced from the combustion of fossil fuels by vehicles and various stationary sources, although it is a by-product of all combustion-based systems and all high-temperature industrial processes. CO is a damaging air pollutant that can be toxic at high concentration levels [22], these pollutants are detrimental to the environment and have serious impacts on human health [23].

When compared to the WHO Global Air Quality Guidelines 2021 standard, CO concentrations in Padang city during peak periods are still within acceptable limits. The WHO indoor air quality guidelines stipulate that CO concentrations should not exceed 10 mg/m^3 for an 8-hour average, while for ambient air, the WHO 2021 standards generally refer to the National Ambient Air Quality Standards (NAAQS) set by the United States EPA. The EPA sets national ambient air quality standards (NAAQS) for carbon monoxide along with five other pollutants considered harmful to public health and the environment. Based on these standards, the maximum concentrations recorded in Padang in 2020 are still within the acceptable category, although close to the threshold of special concern.

A comparison with air quality conditions in major Indonesian cities shows an interesting pattern. Jakarta, as the capital city with high pollution levels, recorded a current CO concentration of around 17 ppb which is still in the good category, but this condition can fluctuate significantly depending on the season and traffic conditions. An analysis of Government Regulation No. 22 of 2021 on Environmental Protection and Management Guidelines reveals that the ambient air quality standard for CO in Indonesia is set at 10,000 µg/m^3 for a 1-hour period [11]. Ambient air quality standards can be seen in Table 5.

Table 5. Ambient Air Quality Standards

No	PARAMETERS	MEASUREMENT TIME	QUALITY STANDARDS	MEASUREMENT SYSTEM
1.	Sulfur Dioxide (SO2)	1 hour	150 µg/m3	active continuous

No	PARAMETERS	MEASUREMENT TIME	QUALITY STANDARDS	MEASUREMENT SYSTEM
				active manual
		24 hour	75 μg/m3	active continuous
		1 year	45 μg/m3	active continuous
2.	Carbon Monoxide (CO)	1 hour	10000 μg/m3	active continuous
		8 hour	4000 μg/m3	active continuous
3.	Nitrogen Dioxide (NO2)	1 hour	200 μg/m3	active continuous active manual
		24 hour	65 μg/m3	active continuous
		1 year	50 μg/m3	active continuous
4.	Photochemical oxide (Ox) As Ozone (O3)	1 hour	150 μg/m3	active continuous active manual
		8 hour	100 μg/m3	active continuous
		1 year	35 μg/m3	active continuous
5.	Non Methane Hydrocarbons (NMHC)	3 hour	160 μg/m3	active continuous
	Dust particulates <100 μg/m3 (TSP)	24 hour	230 μg/m3	active manual
6.	Dust particulates <10 μg/m3 (PM 10)	24 hour	75 μg/m3	active continuous aktif manual
		1 year	40 μg/m3	active continuous
	Particulate dust < 2.5 μg/m3 (PM 2.5)	24 hour	55 μg/m3	active continuous active manual
		1 year	15 μg/m3	active continuous
7.	Lead (Pb)	24 hour	2 μg/m3	active manual

The research findings show that in 2020, two locations in Padang, Balai Kota (12,123 μg/m^3) and Pasar Lubuk Buaya (14,596 μg/m^3) exceeded the threshold. However, the consistent and significant downward trend in subsequent years suggests substantial improvements in air quality, likely due to various factors including the impact of the COVID-19 pandemic reducing vehicle mobility in 2020-2021, as well as the implementation of more effective emission control policies.

Padang's geographical and meteorological context as a coastal city with typical sea-land wind patterns plays an important role in the dispersion of air pollutants. These characteristics differ from cities in Java which generally have a more enclosed topography and much higher population density. The high population density and concentration of economic activities in big cities leads to consistently poor air quality, with particulates (PM2.5 and PM10), nitrogen dioxide (NO2) and sulfur dioxide (SO2) often exceeding safe limits. This explains why Padang, despite experiencing an increasing number of vehicles as its population grows, still shows relatively better air quality conditions compared to metropolitan areas in Java.

The public health implications of these findings are important to consider. Although CO concentrations in Padang have shown an encouraging downward trend, long-term exposure to air pollutants remains a major concern. Epidemiological research shows that there is no safe threshold for exposure to air pollutants, and even concentrations that are within "normal limits" can have cumulative impacts on respiratory and cardiovascular health. Therefore, continuous monitoring efforts and control of emission sources remain top priorities in urban air quality management.

The temporal dynamics observed in the Padang data, with peak concentrations in period 1 (January-February) and generally lower in period 2 (July-August), are consistent with the seasonal patterns commonly found in the tropics. Meteorological conditions in the dry season (period 1) characterized by lower wind speeds and high atmospheric stability tend to reduce pollutant dispersion, while the wet season (period 2) with higher rainfall and atmospheric turbulence facilitates more effective pollutant leaching and dispersion.

Regional comparative studies show Padang is well positioned for CO pollution control compared to other Southeast Asian cities. However, a key challenge is to maintain this positive trend in the face of projected economic growth and continued urbanization. The experience of major Indonesian cities and developing countries proves that without proactive and comprehensive policy interventions, rapid economic growth can significantly reverse air pollution control gains.

This research presents a significant methodological and substantive update through the application of a Systematic Literature Review (SLR) approach integrated with five-year longitudinal monitoring data (2020-2024) at four heterogeneous strategic points of RTH Imam Bonjol, SMA 1 Padang, Balai Kota, and Lubuk Buaya Market that represent variations in the typology of urban public spaces. Unlike previous studies that were limited to a single spatial or short temporal analysis, this study incorporates a comprehensive temporal-spatial perspective by utilizing the ISPU framework based on the latest regulation of PP No. 22/2021, while analyzing the unique impact of the COVID-19 pandemic period on CO pollution dynamics. The empirical findings show a drastic decrease in CO concentration from 14,596 $\mu g/m^3$ (2020) to 286 $\mu g/m^3$ (2024), a phenomenon that has never been systematically documented in Padang, thus providing a valuable evidence-based contribution to the development of air pollution control policies in Indonesia.

CONCLUSION AND RECOMMENDATION

Conclusion

Motor vehicles are a significant source of carbon monoxide (CO) emissions in the ambient air, where CO formation occurs due to incomplete combustion of fuel in the engine. Various factors such as engine design, operating conditions, and the presence of emission control technologies affect the amount of CO released. These CO emissions have far-reaching negative impacts on air quality, human health, and the environment as a whole, including an increased risk of respiratory diseases and nervous system disorders. Therefore, efforts to control CO emissions from the transportation sector are very important to achieve better air quality and support sustainable development in Padang city.

The threshold for the presence of carbon monoxide gas in ambient air is 10,000 ($\mu g/M^3$), and the measurement results shown in the data indicate that the carbon monoxide gas content in the ambient air of Padang City is still far from the permitted limit. However, air monitoring should always be carried out to monitor the presence of carbon monoxide gas at each measurement period each year.

The rapid development of development, including the existence of educational facilities, health facilities, transportation facilities, as well as the development of recreational facilities, tourist attractions, and economic facilities, will attract urbanization to Padang City. This condition will lead to increased traffic flow, and the domino effect of this condition is an increase in air emissions which will increase along with the number of vehicles operating to and from Padang City.

The installation of air quality monitoring devices in congestion-prone areas will have direct functions and benefits for the community, with a warning system about air pollution levels reaching dangerous thresholds, especially for vulnerable groups such as children, the elderly, and people with respiratory and heart diseases, so that they can take preventive measures. In addition, the real-time presentation of air quality information will be useful for people to plan outdoor activities, avoid areas with high pollution, or choose safer times for activities.

Recommendation

The Padang city government plays a crucial role in conducting regular and systematic air quality monitoring, especially of nitrogen gas concentrations. This monitoring is an important foundation for identifying pollution levels and trends, where accurate monitoring data provides a clear picture of current NOx pollution levels and how they trend over time. This allows the government to gauge the severity of the problem and identify key sources of pollution. In addition, information on NOx concentrations in ambient air is critical for assessing public health risks, as long-term exposure to NOx can trigger or exacerbate various respiratory problems, such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD), as well as negatively impact the cardiovascular system. Monitoring data also provides a strong scientific basis for formulating targeted policies and regulations in air pollution control; without valid data, control efforts can be inefficient and lack impact. Once policies and regulations are implemented, continuous monitoring is needed to evaluate their effectiveness in reducing air pollution levels, where the results of this evaluation will be the basis for making adjustments and improvements to future policies. Finally, transparent air quality data that is easily accessible to the public can increase public awareness of the importance of air quality and encourage active participation in environmental protection efforts.

Given that motor vehicles are one of the main contributors to NOx emissions in urban areas, the Padang City government needs to take decisive steps in regulating this sector. Some measures that could be considered include implementing stricter emission standards by adopting higher exhaust emission standards for new and operating vehicles in Padang City, which could be phased in following more advanced national or even international standards. In addition, effective monitoring and enforcement need to be improved through regular emission tests and strict enforcement of violations, which requires adequate testing infrastructure and competent human resources. The government can also incentivize the use of environmentally friendly vehicles, such as electric vehicles, hybrid vehicles, or cleaner alternative fuel vehicles, with incentives such as tax breaks, purchase subsidies, or priority parking. The development of sustainable public transportation is also important, where investments in efficient, affordable, and convenient public transportation systems can encourage people to switch from using private vehicles, thereby reducing traffic volumes and exhaust emissions. In addition, efficient traffic management by implementing smart traffic management systems can help reduce congestion, which directly contributes to increased exhaust emissions due to vehicle idling. Finally, the implementation of age-restriction policies for vehicles operating in the city, especially for commercial and public transport vehicles that tend to have higher emissions, should also be considered.

The adverse impact of motor vehicle exhaust emissions on public health is the main reason why air pollution control measures are so important. Therefore, the Padang City government needs to take proactive measures to protect and improve the health of its citizens, including by increasing public awareness and education on the dangers of air pollution and ways to reduce exposure, such as wearing masks when air quality is poor, reducing outdoor activities when pollution is high, and choosing cleaner transportation. In addition, the provision of real-time air quality information is crucial, where easy and quick access for the public to the latest air quality information can be provided through digital platforms or other public information media, allowing the public to take the necessary precautions. Strengthening the health system also needs to be done by increasing the capacity of health facilities and medical personnel in dealing with diseases related to air pollution, such as respiratory and cardiovascular diseases. The development of green open spaces should also be prioritized, by increasing the extent and quality of green open spaces in urban areas, such as city parks and greenways, as vegetation plays an important role in absorbing air pollutants and creating a healthier environment. In addition, promotion of healthy lifestyles, such as walking, cycling and exercising in green open spaces when air quality is good, should also be encouraged. Finally, cross-sectoral cooperation is essential, involving various parties, including the health, environment, transportation, and education sectors, in efforts to control air pollution and protect public health.

The installation of air quality monitoring devices in congestion-prone areas, such as in Padang which may have certain choke points, has a number of significant benefits, both directly and indirectly. The presentation of real-time and accurate data in public spaces is particularly beneficial for; Measuring Pollution Levels Directly: Monitoring devices provide real-time data on the concentration of various air pollutants generated by motor vehicles, such as fine particulate matter (PM2.5, PM10), carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), and ozone (O_3). These data are more accurate and representative than air quality estimates or models. Identifying Pollution Hotspots: Strategically placed in traffic-prone areas, this tool can identify specific locations with the highest pollution levels. This information is crucial for focused intervention and resource allocation. Monitoring Trends and Changes: Continuously collected data allows monitoring of air quality trends over time, including changes that occur due to specific policies (e.g., traffic engineering) or seasonal factors.

Air quality information is not just technical data, but a very important tool to empower communities. With a better understanding of air quality and its impact on health, communities can take proactive steps to protect themselves, encourage healthier and sustainable behavior changes, and actively participate in collective efforts to create a cleaner and healthier air environment for all. In Padang, with the air pollution challenges that may exist, access to accurate and easy-to-understand air quality information will be a crucial step in raising public awareness and concern.

Monitoring nitrogen gas in the ambient air of Padang City is not just data collection, but a crucial first step in realizing sustainable development. The Padang City Government has a great responsibility to utilize this monitoring data as a basis for formulating and implementing effective regulations on motor vehicle exhaust emissions. In addition, proactive efforts to improve public health through education, information provision, health system strengthening, and green open space development are integral steps. With comprehensive and sustainable actions, Padang City can create a cleaner, healthier air environment that supports the quality of life of its citizens, while contributing to the overall achievement of sustainable development goals. Suggestions for further research are that this research data is expected to be developed such as adding measurements of particles that can pollute ambient air quality in Padang city in the form of other pollutant substances besides CO, and conducting research at several different locations in Padang city.

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