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RESEARCH ARTICLE

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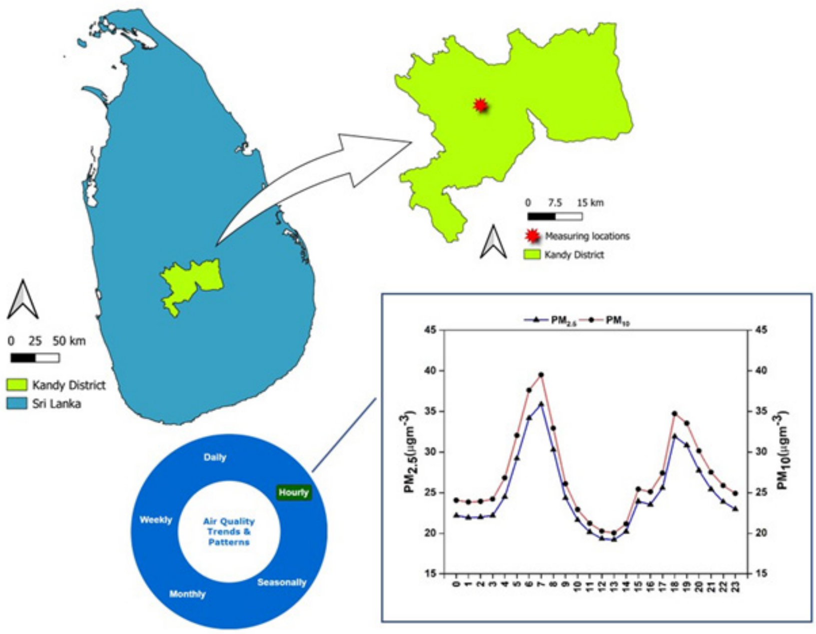

Highlights

- The daily $PM_{2.5}$ concentration in Kandy was bimodal, with peaks in the early morning and late afternoon.
- $PM_{2.5}$ levels vary noticeably on a daily, weekly, and monthly basis.
- The levels of $PM_{2.5}$ were affected by factors such as wind speed, wind direction, and precipitation.

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Abstract: Air pollution is the leading environmental hazard that has devastating health effects on human health. Identification of trends and patterns of air pollution is crucial in a specific geographic area to inform and implement effective control and mitigation measurements. Standard air pollution monitoring networks are costly for most low-and middle-income countries. The aim of this study was to investigate the variations in the mean concentrations of air pollutants that occur at various times of the day, days of the week, months of the year, and seasons during the period of January 2019 to December 2019 in Kandy, Sri Lanka using low-cost sensors. A regression analysis with dummy variables was used to model the relationship between the concentrations of air pollutants and categorical independent variables, the time of day and day of the week. Considering temporal variations, the study found that pollution is highest in the early morning and evening, and lowest in the afternoon. The worst days for the air quality were Wednesdays and Thursdays, while Sundays had the lowest $PM_{2.5}$ pollution. The analysis of air quality variations by month showed that December had the lowest air pollution of the examined months. The variation in $PM_{2.5}$ was greatly influenced by wind speed, wind direction, and rainfall patterns. The study emphasized the importance of long-term consistently management and monitoring of air pollution levels.

***Keywords*:** Air quality; $PM_{2.5}$; low-cost sensors; trends and patterns

INTRODUCTION

Particulate matter (PM) is one of the major atmospheric pollutants. It is comprised of airborne solid and liquid particles. While some large particles such as soot, dust, or dirt can be seen with the naked eye, smaller particles are not visible without magnification tools. Both natural and human activities contribute to the production of PM (Rodríguez et al., 2004). Most of the time, the naturally generated PM is more difficult to exert control of, as a result, they are typically unregulated. Typically, in urban settings, man-made PM air pollution is substantially greater than natural PM air pollution. The standards of PM have been introduced by international local agencies, based on health effects related to PM and, monitoring and regulation of PM are essential in terms of human health. To control PM in the atmosphere in a specific geographic area, it is critical to understand their sources, chemical composition (Abdeen et al., 2014; Shiferaw et al., 2023), dispersion patterns, and trends both spatially and temporally.

The generation of PM is most commonly attributed to the burning of fossil fuels (Maciejczyk et al., 2021), various industrial combustion processes, and vehicle emissions. The growing public awareness of PM is mainly due to its potentially harmful effects on human health. In their recent publications, the World Health Organization (WHO) reported that PM affects more people than any other pollutant on a global scale (World Health Organization, 2021). According to the size of the particles and their health effects, and criteria pollutants standards, PM is divided into two categories: $PM_{2.5}$ (fine particles less than 2.5 µm) and PM_{10} (particles less than 10 µm). The breadth of the scientific literature revealed that $PM_{2.5}$ is associated with a plethora of health effects, however, primarily linked to cardiovascular and respiratory diseases (Wang et al., 2021; Xing et al., 2016).

Measuring ambient air pollutants is a crucial aspect of air quality monitoring and management. The trends and patterns of air quality in specific geographic locations are important to improve/revise air quality guidelines, implement strategies to reduce air pollution and evaluate the impact on health and the environment. To better understand and address air quality issues, it is important to have reliable and continuous air quality monitoring data. The use of the US Federally Equivalent Monitors (FEMs) for air quality monitoring is costly and demands specific training and expertise to operate and maintain the equipment properly. Implementation and maintenance of a country-wide network of FEMs, especially in low-resource settings like Sri Lanka, is challenging. Low-cost air quality monitors have been proposed as a potential solution (Feenstra et al., 2019) to overcome some of these challenges. These monitors are more accessible

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and affordable and can be deployed in larger numbers, providing a more comprehensive picture of air quality trends and patterns. This study aimed to evaluate trends and patterns of air pollution in two of the major cities in Sri Lanka, Colombo, and Kandy.

MATERIALS AND METHODS

Data collection

A small, low-cost air quality monitor called the "KOALA" (Knowing Our Ambient Local Air quality) was utilized in this study. The monitors were designed and calibrated by the International Laboratory for Air Quality and Health (ILAQH) at Brisbane's Queensland University of Technology (QUT) (Liu et al., 2020). The operating principle of the PM sensor in the KOALA monitor (Plantower PMS1003) is based on the laser light scattering technique. A small fan draws a continuous stream of ambient air through a detection chamber, where the particulate matter in the air scatters coherent laser light. A photodetector detects the scattered light and converts the optical signal into an electrical signal, amplified and processed (Liu et al., 2020).

Before deploying the sensors in the field, they were calibrated using a Beta Attenuation Monitor (BAM) to ensure the accuracy and dependability of measurements in the local environment. The calibration process entails adjusting the sensor response to match the BAM's response to specific particulate matter types and concentrations. The calibration factor obtained was then applied to the measured signal to obtain accurate and precise particulate matter concentration readings. One sensor was installed in 2019 at the National Institute of Fundamental Studies (NIFS), Kandy was used to derive the temporal variation.

Statistical analysis

A regression model analysis (RMA) with a reference category was used to examine the differences in mean concentrations of air pollutants at various periods, including hours of the day, days of the week, months of the year, and seasons. Regression analysis with a reference category was commonly used when a categorical independent variable possesses a meaningful baseline or comparison group.

For example, to analyze the hourly variations, a set of 23 dummy variables was created to represent each hour of the day, while selecting the reference category. A similar approach was followed for the analysis of daily variations, where 6 dummy variables represented each day of the week, with one chosen as the reference category. For the analysis of monthly variations, 11 dummy variables were created to represent each month of the year, with one serving as the reference. In addition, the study explored seasonal variations by employing 3 dummy variables to represent each season, with one season designated as the reference. The criteria for selecting a reference category for dummy variables in a regression analysis model are based on the interpretability of the results, as well as the practical implications for the hypotheses, which involve comparing different intervals.

The dummy variables created were then incorporated as independent variables in the regression model. The regression analysis estimated the coefficients for each dummy variable, which reflected the differences in mean concentrations of air pollutants in comparison to the reference category. These coefficients provided insights into the variations in air pollutant concentrations across different periods while accounting for the reference category. The statistical analysis enabled the investigation of how air pollutant concentrations varied throughout the day, week, month, and season, considering a meaningful baseline or comparison group.

A wind-rose diagram was created in R using the "open-air" package to investigate the relationship between wind direction and $PM_{2.5}$ concentrations. Pollutant concentrations were overlaid on the wind rose diagram, which displayed the frequency of wind directions. This visualization technique identified wind directions associated with higher or lower $PM_{2.5}$ concentrations. The wind rose diagrams for four different monsoon seasons were created to investigate seasonal variations in pollutant transport patterns.

All the statistical calculations were carried out using R software (*R: A Language and Environment for Statistical Computing*), and the interactive graphs were produced using an "open-air" package (Carslaw & Ropkins, 2012).

RESULTS

Daily and hourly variations

In this study, sensor data was collected throughout 2019, offering a comprehensive and uninterrupted dataset for the analysis. Figure 1 shows daily variations of ambient air pollutants during 2019 at Kandy. We considered Monday to Saturday as weekdays/working days and Sunday as a weekend. The lowest daily mean concentrations of ambient $PM_{2.5}$ and PM_{10} were reported on Sundays, with approximately 23.4 μgm^{-3} (95% CI: 22.8, 24.0) and 25.1 μgm^{-3} (95% CI: 24.4, 25.8), respectively.

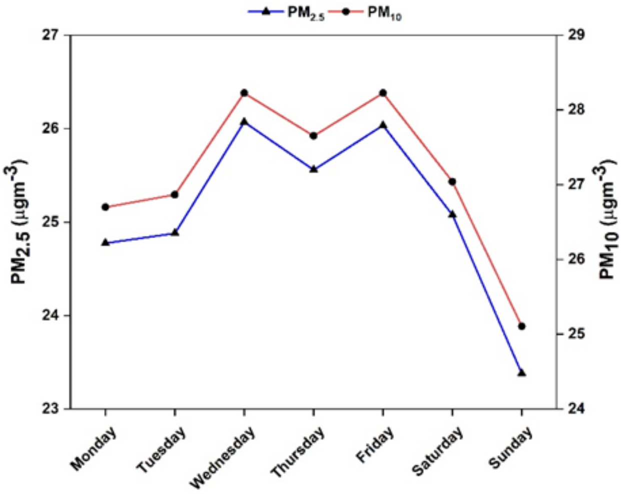

Figure 1: Daily variations of ambient $PM_{2.5}$, and PM_{10} concentrations in Kandy during the year 2019

The regression analysis revealed significant differences in $PM_{2.5}$ concentrations between days of the week ($p < 0.05$) (Table 1). Sunday had a statistically significant decrease in mean $PM_{2.5}$ compared to the reference day (Monday) (coefficient = - 1.3954, p = 0.003), showing that $PM_{2.5}$ was generally a minimum on Sundays. Wednesday had an increased $PM_{2.5}$ (coefficient = 1.2956, p = 0.005), showing significantly higher levels of $PM_{2.5}$ than Mondays. On the other hand, Tuesday, Thursday, and Saturday showed non-significant differences in mean $PM_{2.5}$ compared to Monday, showing similar levels of air pollution on those days. Similar results were observed for PM_{10} during the period (Table S1).

Figure 2 shows hourly diurnal variations in $PM_{2.5}$ and PM_{10} concentrations in Kandy for 2019, indicating that the $PM_{2.5}$ and PM_{10} patterns were similar. In the hourly variation, two peaks were observed for ambient $PM_{2.5}$ and PM_{10}, one in the morning (07:00) and another in the evening (18:00). The evening peaks with 31.9 μgm^{-3} (95% CI: 30.7, 33.1) and 34.7 μgm^{-3} (95% CI: 33.4, 36.1) for $PM_{2.5}$ and PM_{10} were significantly lower than the morning peaks.

There are two peaks in morning rush hours (06.00 – 08.00) and evening rush hours (17.00 – 19.00). Two valleys are visible in the hourly $PM_{2.5}$ and PM_{10} concentrations from mid-morning to early evening (10:00 to 15:00) and late night to early morning (21:00 to 03:00). Traffic emissions contribute to $PM_{2.5}$ levels, but their significant impact is usually observed later in the morning when people start their commutes. The morning peak around 7 AM is influenced by traffic emissions to some extent, but it is primarily due to particles growing through the absorption of moisture. Humidity measures the amount of water vapor in the air, and higher humidity allows the air to hold more particulate matter. This occurs because water vapor molecules can attach to particulate matter, increasing their size and weight (Jayaratne et al., 2018). In the early morning, humidity tends to be elevated because the air cools overnight, reducing its capacity to hold water vapor, which then condenses into dew or fog. As shown in figure 3, heightened humidity leads to an increase in PM levels. As the sun rises and the air warms up, water vapor evaporates, lowering the humidity. This decrease in humidity results in a reduction in PM levels. The latter valley is almost certainly due to reduced pollution from vehicles as well as a reduction in humidity.

The regression analysis model showed significant hourly variations in $PM_{2.5}$ concentrations ($p < 0.05$) (Table 2). Hour 07:00 exhibited a significant increase in mean pollutant concentration (coefficient = 13.70, $p < 0.000$) when compared to the reference hour (Hour 00:00). The data shows that air pollutant levels were elevated during the early morning, particularly at 07:00. At hour 14:00, compared to the reference hour the lowest mean pollutant concentration (coefficient = -1.97, $p < 0.001$) was observed. A decreasing pattern of air pollution occurs from 7:00 hours

Table 1: Regression analysis model for mean $PM_{2.5}$ (μgm^{-3}) on day of the week based on hourly data during the year 2019, Kandy.

Day of the Week	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
Monday	0 (Reference)	-	-	-	-	-
Tuesday	0.1052	0.4643	0.23	0.821	-0.8049	1.0152
Wednesday	1.2956	0.4649	2.79	0.005	0.3843	2.2069
Thursday	0.7824	0.4639	1.69	0.092	-0.1270	1.6919
Friday	1.2596	0.4639	2.71	0.007	0.3502	2.1691
Saturday	0.3003	0.4635	0.65	0.517	-0.6084	1.2089
Sunday	-1.3954	0.4652	-3.00	0.003	-2.3073	-0.4835

* The average concentration of PM2.5 on Monday during the study period (24.78) was considered the reference category.

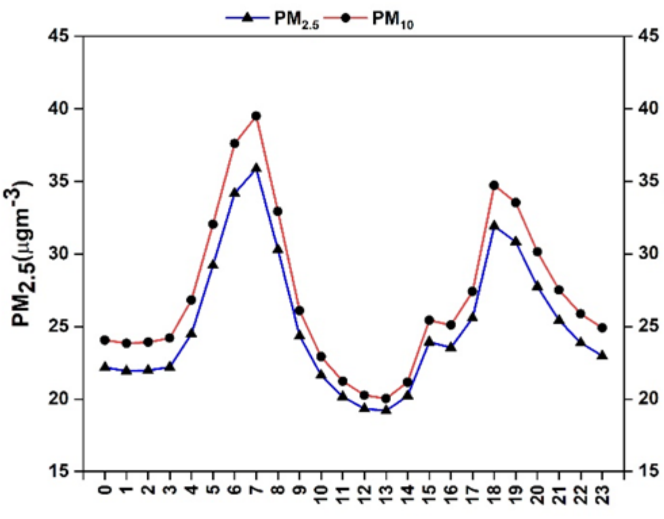

Figure 2: Hourly variations of ambient $PM_{2.5}$, and PM_{10} concentrations in Kandy during the year 2019

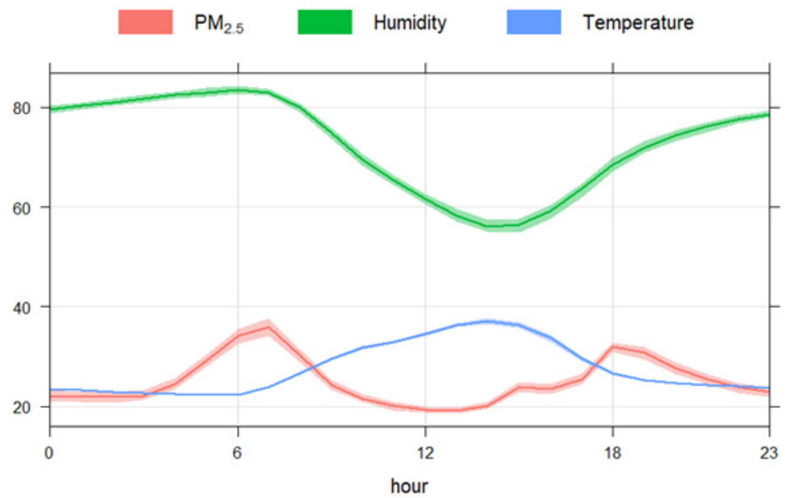

Figure 3: Diurnal Variation of the $PM_{2.5}$ concentration, Humidity and Temperature

until 14:00 hours, then tends to increase again until 18:00 hours, and then decreases again. This shows lower air pollution during the mid-day. At hour 18:00 $PM_{2.5}$ showed a significant increase in mean pollutant concentration (coefficient = 9.74, $p < 0.001$) compared to the reference hour. In summary, the study reveals diurnal fluctuations in $PM_{2.5}$ & PM_{10} concentrations, exhibiting discernible trends during particular time intervals (Table S2).

Monthly variation

Figure 4 illustrates the 2019 monthly variations of $PM_{2.5}$ and PM_{10} concentrations in Kandy. The mean concentrations of $PM_{2.5}$ and PM_{10} in the ambient air were significantly higher (34.87 μgm^{-3} and 38.51 μgm^{-3}) in March 2019, whereas the lowest mean concentrations of both pollutants were found in December (17.76 μgm^{-3} and 18.45 μgm^{-3}).

Table 2: Regression analysis model for the hourly variation of $PM_{2.5}$ (μgm^{-3}) during the year 2019, Kandy.

Hour	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
00:00	0 (Reference)	-	-	-	-	-
01:00	-0.2462	0.7816	-0.32	0.753	-1.7783	1.2858
02:00	-0.2039	0.7822	-0.26	0.794	-1.7371	1.3293
03:00	0.0108	0.7828	0.01	0.989	-1.5236	1.5452
04:00	2.3112	0.7846	2.95	0.003	0.7732	3.8492
05:00	7.0254	0.7828	8.98	0.001	5.4910	8.5599
06:00	11.9911	0.7834	15.31	0.001	10.4555	13.5267
07:00	13.6977	0.7846	17.46	0.001	12.1597	15.2357
08:00	8.1056	0.7828	10.36	0.001	6.5711	9.6400
09:00	2.1703	0.7822	2.77	0.006	0.6371	3.7035
10:00	-0.5441	0.7816	-0.7	0.486	-2.0762	0.9879
11:00	-2.0250	0.7816	-2.59	0.010	-3.5570	-0.4929
12:00	-2.8414	0.7816	-3.64	0.001	-4.3734	-1.3093
13:00	-2.9899	0.7816	-3.83	0.001	-4.5219	-1.4578
14:00	-1.9661	0.7822	-2.51	0.012	-3.4993	-0.4328
15:00	1.7430	0.7822	2.23	0.026	0.2098	3.2762
16:00	1.3543	0.7822	1.73	0.083	-0.1789	2.8875
17:00	3.4079	0.7822	4.36	0.001	1.8747	4.9412
18:00	9.7354	0.7822	12.45	0.001	8.2022	11.2686
19:00	8.6548	0.7822	11.07	0.001	7.1216	10.1880
20:00	5.5629	0.7822	7.11	0.001	4.0296	7.0961
21:00	3.2425	0.7822	4.15	0.001	1.7093	4.7758
22:00	1.6952	0.7822	2.17	0.030	0.1620	3.2285
23:00	0.7917	0.7822	1.01	0.311	-0.7415	2.3250

* The average concentration of $PM_{2.5}$ at 00:00 during the entire study period (22.18) was considered the reference category.

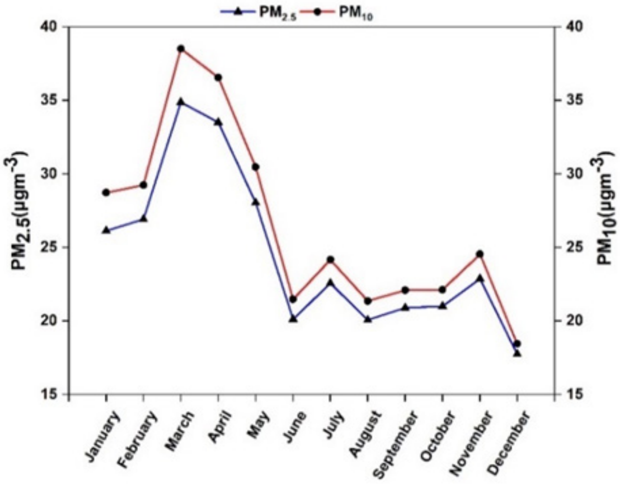

Figure 4: Monthly variations of ambient $PM_{2.5}$ and PM_{10} concentrations in Kandy during 2019.

Table 3 suggests that all of the months have statistically significant effects ($p < 0.05$) on $PM_{2.5}$ based on the regression analysis results. All of the estimated coefficients are positive, indicating that the average $PM_{2.5}$ during these months will be higher than it was in December. The highest significant increase in mean $PM_{2.5}$ was observed in March (coefficient = 17.1132, $p < 0.05$). In comparison to the first five months, the mean $PM_{2.5}$ is significantly lower in June, July, August, September, and October and PM_{10} produced results similar results (Table S3).

Seasonal variation

Sri Lanka has no distinct seasons, unlike countries in the temperate zone. However, based on the rainfall patterns influenced by the monsoon winds of the Indian Ocean and the Bay of Bangel, the rainy seasons have been divided into two main seasons (Department of Meteorology), Southwest (May to September) and Northeast (December to February), and two inter monsoons, the first inter-monsoon (March-April) and the second inter-monsoon (October to November). Figure 5 shows that $PM_{2.5}$ concentration varies according to the monthly wind direction.

According to that, March and April show high concentration with East, Southeast direction. From May to October, $PM_{2.5}$ concentration levels ranged from 15 to 30 µgm^{-3} in the Southwest wind direction. Figure 6 shows the highest $PM_{2.5}$ concentration at the first inter-monsoon and the lowest at the Southeast monsoon.

Figure 7 shows the time series graph of $PM_{2.5}$ daily mean concentration in 2019 at the monitoring location. Red and blue dashed lines indicate the WHO 24-hr average $PM_{2.5}$ standard value (15 µgm^{-3}) and the Sri Lankan 24-hr average $PM_{2.5}$ standard (50 µgm^{-3}). According to the WHO guideline, 97.6% of days exceeded the standard value, 99% of days well below the 24-hour local standard value. A Sudden spike in $PM_{2.5}$ concentration was observed from November 1st to November 19th (area in grey colour), due to the transboundary air pollution (Abeyratne & Ileperuma, 2006).

According to the US EPA AQI, most days had moderate air quality (Figure 8).

Table 3: Regression analysis model for the monthly variation of $PM_{2.5}$ (µgm^{-3} during the year 2019, Kandy).

	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
January	8.3704	0.6699	12.5	<0.001	7.0572	9.6835
February	9.1622	0.6799	13.48	<0.001	7.8293	10.4950
March	17.1132	0.6699	25.55	<0.001	15.8000	18.4263
April	15.7429	0.6781	23.22	<0.001	14.4136	17.0722
May	10.2790	0.6744	15.24	<0.001	8.9570	11.6010
June	2.3564	0.7479	3.15	0.002	0.8904	3.8224
July	4.8128	0.6767	7.11	<0.001	3.4864	6.1392
August	2.3103	0.6699	3.45	0.001	0.9971	3.6234
September	3.1368	0.6837	4.59	<0.001	1.7966	4.4771
October	3.2470	0.6699	4.85	<0.001	1.9338	4.5601
November	5.1140	0.6730	7.6	<0.001	3.7947	6.4333
December	0 (Reference)	-	-	-	-	-

* The average concentration of PM2.5 in December during the study period (17.76) was considered the reference category.

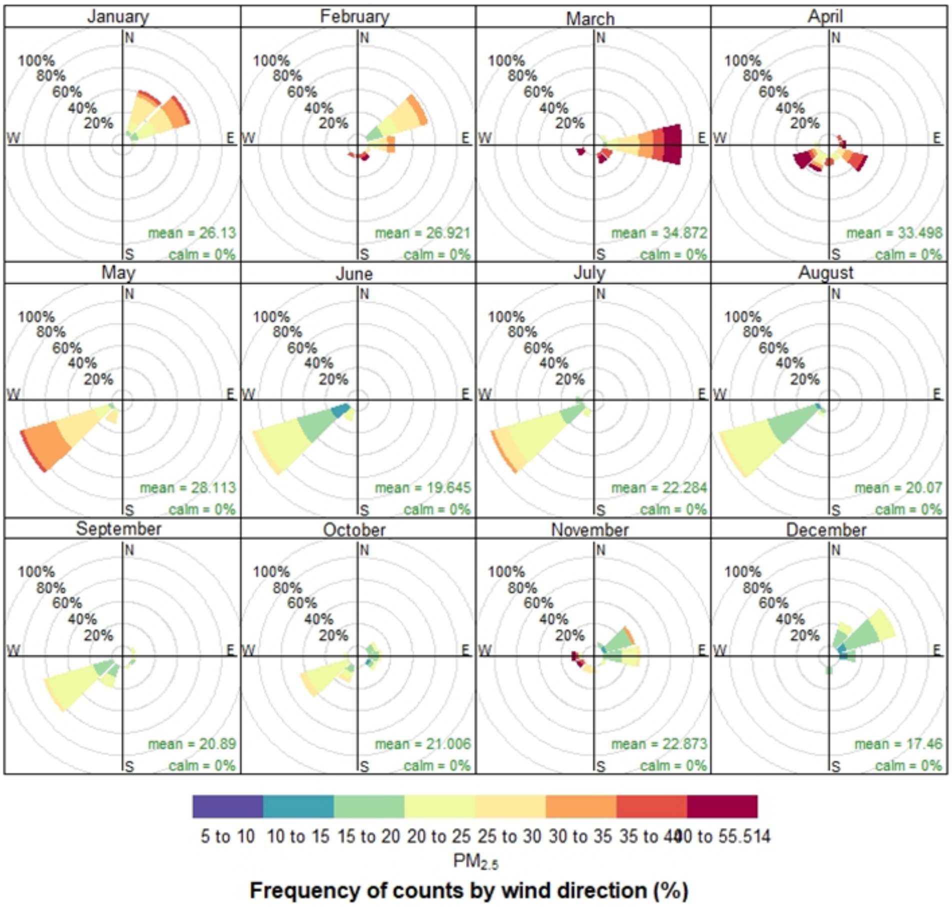

Figure 5: Monthly-wise $PM_{2.5}$ variation with wind direction

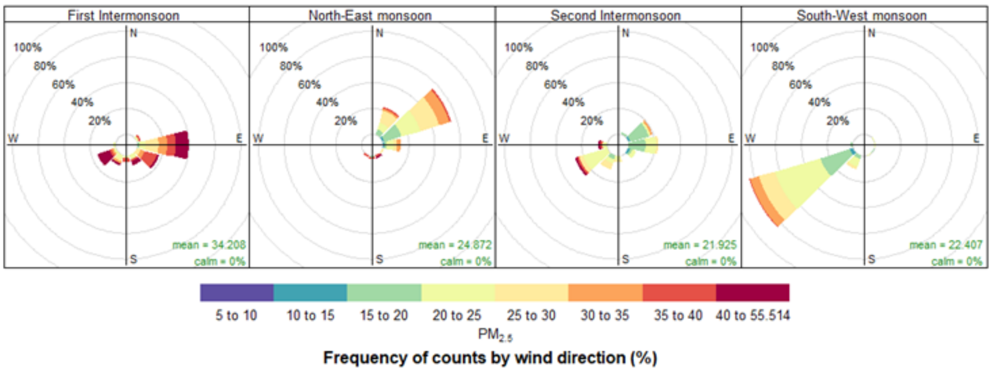

Figure 6: Seasonal variation of $PM_{2.5}$ with wind direction

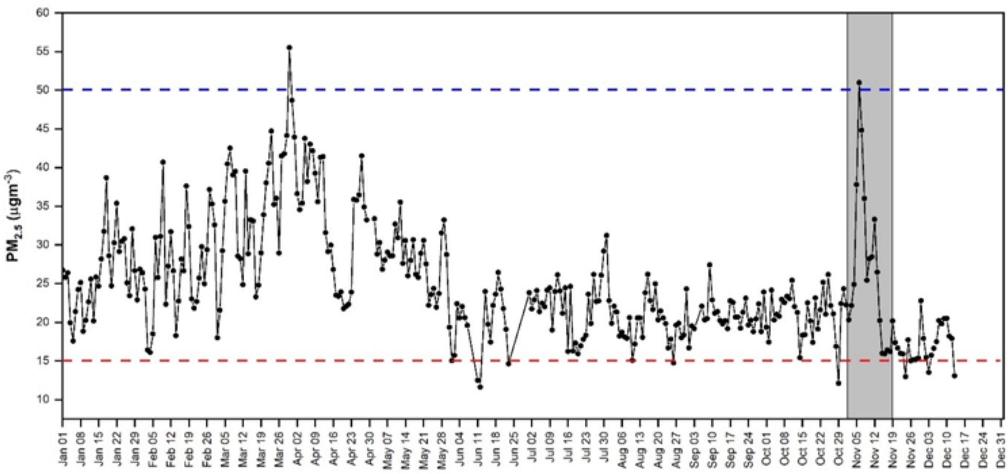

Figure 7: Daily average of $PM_{2.5}$ concentration (Red dashed line - WHO 24-hr average $PM_{2.5}$ standard, blue dash line – Sri Lankan 24-hr average $PM_{2.5}$ standard)

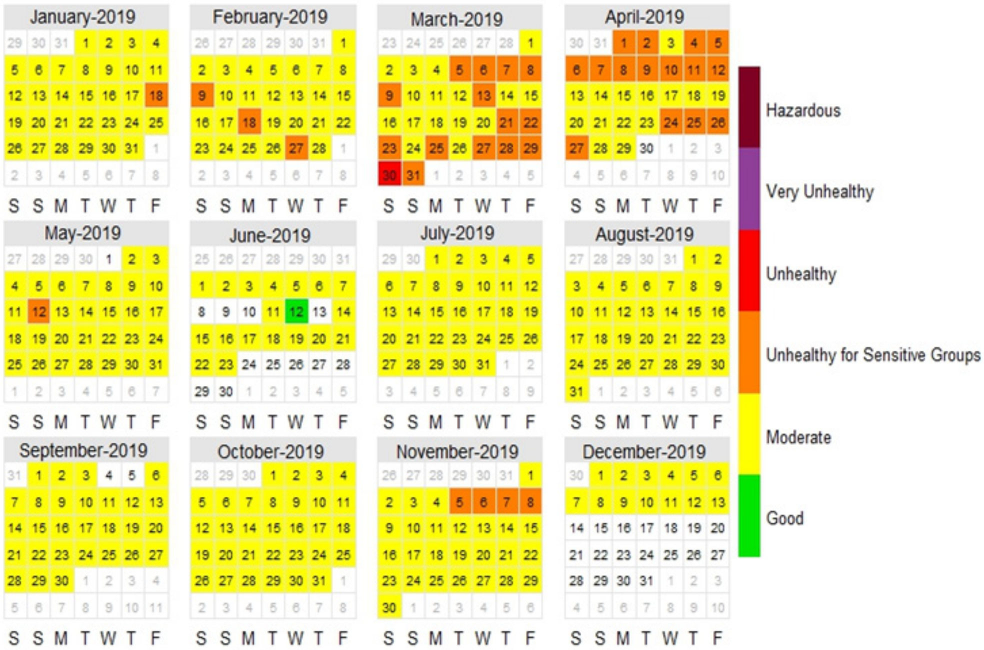

Figure 8: Calendar plot of three monitoring sites at Kandy area in 2019.

DISCUSSION

The present study investigated the diurnal, weekly, and monthly variations in air quality in Kandy in terms of $PM_{2.5}$ and PM_{10} over the year 2019. The findings revealed distinct patterns in air quality fluctuations throughout different time scales in Kandy. Specifically, the study identified the early morning and evening as the periods with the poorest air quality. In contrast, the mid-day exhibited the most favorable air quality during the day. This observation can be attributed to a range of factors, including increased atmospheric mixing, higher wind speeds, and reduced emissions from certain anthropogenic sources. These conditions facilitate the dispersion and dilution of pollutants, resulting in better air quality during mid-day and the early afternoon.

Since Kandy is the country's second-largest city, commuters come to the city center to avail themselves of government services, for commercial purposes, and a large number of school children come into the city daily from the outskirts. By the commencement of the working days, vehicle traffic emission considerably increases. Therefore, daily mean concentrations of $PM_{2.5}$ and PM_{10} has grown and reached their maximum at around 26.07 and 28.23 μgm^{-3}, respectively, on Wednesdays. For weekly variation, air quality from Wednesday to Thursday is the worst, while Sundays exhibited the lowest air pollution, obviously due to a lack of human activities such as traffics, industrial operations, and commercial activities. Although Saturday is recognized as a weekend in Sri Lanka, most businesses and some government sectors deliver their services half the day on Saturday. So, it seems to be affected to record a significant amount of mean concentration of ambient PM on Saturday compared to Sunday.

The monthly analysis revealed that December had the best air quality among the studied months. PM can be washed away from the air by rain through wet deposition. Wet deposition occurs when raindrops capture airborne particles and deposit them on the ground, effectively removing them from the atmosphere (Slinn, 1977). In addition to wet deposition, rain can help disperse $PM_{2.5}$ particles in the air. As the rain falls, it creates turbulence in the atmosphere, which can help to disperse the particles. This can lead to a temporary reduction in $PM_{2.5}$ levels in the air (Tian et al., 2021).

In 2015, a study in Beijing (Chen et al., 2015) with 35 air quality monitoring stations found that the highest $PM_{2.5}$ concentrations observed late at night and early in the morning. The basic trend of the monitoring stations showed two valleys in the morning and afternoon and two peaks in the middle of the day and late at night. Aside from that, the study showed that the concentrations of $PM_{2.5}$ were lowest on Sundays and higher on Wednesday to Friday. The concentrations of $PM_{2.5}$ are low at all stations in May, June, and August.

A study in India 2019 (Agrawal et al., 2021) found that the PM levels in two cities (Patiala and Bulandshahr), exhibited similar patterns. In both cities, PM levels were highest in the morning from 6 AM to 9 AM and lowest in the afternoon from 1 PM to 4 PM. A Study by Shi et al 2012 in Hong Kong states that there were two peaks in $PM_{2.5}$ concentrations during morning and evening rush hour times, attributed to dense traffic (Shi et al., 2012). Additionally, $PM_{2.5}$ concentrations were found to be higher on weekdays compared to weekends, indicating the influence of anthropogenic activities such as traffic emissions. A Study in Southeast Texas (Russell et al., 2004) revealed that the diurnal patterns show a consistent morning peak and a weaker peak in the late afternoon to early evening. High hourly $PM_{2.5}$ concentrations are associated with daily averages above the national air quality standard.

The establishment of robust air quality monitoring systems is imperative for effective environmental management. These systems provide real-time data, enabling early warnings to the public and authorities and allowing prompt responses to mitigate the impact of poor air quality. Strategic investment in research and development to identify pollution sources during specific times enhances understanding, paving the way for targeted and effective solutions. Collaboration among government agencies, communities, and environmental organizations is essential, involving stakeholders in the development of strategies addressing temporal air quality variations. Implementing stricter emission controls during morning and evening rush hours, for example, or implementing policies to reduce traffic congestion can help alleviate diurnal variations in air quality. Finally, the findings emphasize the significance of understanding temporal variations in air quality for effective environmental management and public health initiatives.

CONCLUSION

The findings of this study offer important new information regarding the variations in the mean concentrations of air pollutants that occur during different times of the day, days of the week, months of the year, and different seasons. The findings highlight the importance of comprehensive air quality monitoring programs and tailored interventions to address peak periods of air pollution. Such efforts can make a significant difference in improving overall air quality and protecting public health. Future research should look into the underlying mechanisms that cause these temporal variations, as well as the effectiveness of mitigation strategies in lowering pollution levels during identified critical time periods.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Supplementary Documents

Table S1: Regression analysis model for mean PM_{10} concentrations (μgm^{-3}) on day of the week based on hourly data during the year 2019, Kandy

Day of the Week	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
Monday	0 (Reference)	-	-	-	-	-
Tuesday	0.1666	0.5389	0.31	0.757	-0.8898	1.2231
Wednesday	1.5276	0.5397	2.83	0.005	0.4697	2.5855
Thursday	0.9537	0.5386	1.77	0.077	-0.1020	2.0095
Friday	1.5272	0.5386	2.84	0.005	0.4714	2.5830
Saturday	0.3422	0.5381	0.64	0.525	-0.7126	1.3971
Sunday	-1.5926	0.5400	-2.95	0.003	-2.6512	-0.5339

* The average concentration of PM10 on Monday during the study period (26.70) was considered the base category.

Table S2: Regression analysis model for the hourly variation of PM_{10} (μgm^{-3}) during the year 2019, Kandy

Hour	Coef.	Std. Err.	t	P>t	[95% Conf.]	
01:00	-0.2267	0.9090	-0.25	0.803	-2.0086	1.5553
02:00	-0.1431	0.9097	-0.16	0.875	-1.9264	1.6403
03:00	0.1413	0.9104	0.16	0.877	-1.6434	1.9260
04:00	2.7589	0.9126	3.02	0.003	0.9700	4.5478
05:00	7.9813	0.9104	8.77	0.000	6.1966	9.7660
06:00	13.5384	0.9112	14.86	0.000	11.7523	15.3245
07:00	15.4395	0.9126	16.92	0.000	13.6506	17.2284
08:00	8.8648	0.9104	9.74	0.000	7.0801	10.6495
09:00	2.0256	0.9097	2.23	0.026	0.2422	3.8089
10:00	-1.1471	0.9090	-1.26	0.207	-2.9290	0.6349
11:00	-2.8325	0.9090	-3.12	0.002	-4.6145	-1.0506
12:00	-3.8057	0.9090	-4.19	0.000	-5.5877	-2.0237
13:00	-4.0333	0.9090	-4.44	0.000	-5.8153	-2.2513
14:00	-2.9024	0.9097	-3.19	0.001	-4.6857	-1.1190
15:00	1.3592	0.9097	1.49	0.135	-0.4242	3.1425
16:00	1.0413	0.9097	1.14	0.252	-0.7421	2.8246
17:00	3.3434	0.9097	3.68	0.000	1.5601	5.1267
18:00	10.6645	0.9097	11.72	0.000	8.8812	12.4479
19:00	9.4807	0.9097	10.42	0.000	7.6973	11.2640
20:00	6.0744	0.9097	6.68	0.000	4.2910	7.8577
21:00	3.4577	0.9097	3.8	0.000	1.6744	5.2411
22:00	1.8041	0.9097	1.98	0.047	0.0207	3.5874
23:00	0.8484	0.9097	0.93	0.351	-0.9349	2.6317

* The average concentration of PM10 at 00:00 o'clock during the study period (24.06) was considered the base category.

Table S3: Regression analysis model for the monthly variation of PM_{10} (μgm^{-3}) during the year 2019, Kandy

	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
January	10.2772	0.7780	13.21	0.000	8.7522	11.8022
February	10.7982	0.7896	13.68	0.000	9.2503	12.3461
March	20.0627	0.7780	25.79	0.000	18.5377	21.5877
April	18.1076	0.7875	22.99	0.000	16.5639	19.6514
May	12.0209	0.7832	15.35	0.000	10.4856	13.5561
June	3.0272	0.8685	3.49	0.000	1.3247	4.7298
July	5.7173	0.7858	7.28	0.000	4.1769	7.2578
August	2.9136	0.7780	3.75	0.000	1.3886	4.4387
September	3.6436	0.7940	4.59	0.000	2.0870	5.2001
October	3.6800	0.7780	4.73	0.000	2.1549	5.2050
November	6.0926	0.7816	7.79	0.000	4.5604	7.6248

* The average concentration of PM2.5 in December during the study period (18.45) was considered the base category.

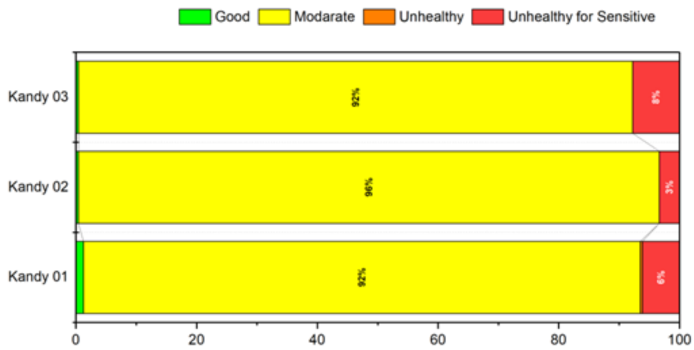

Figure S1: Percentage of dates according to the AQI in each site