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ORIGINAL RESEARCH

The association of temperature, humidity, pressure, air pollution and dusty days with emergency department visits for upper respiratory complaints

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Abstract

Background: The impact of short-term exposure to desert dust days on upper respiratory tract infections (URTI) remains unclear. This study aimed to investigate the association of desert dust days, particulate matter (PM10, PM2.5) levels, and meteorological parameters (temperature, humidity, and pressure) on emergency department visits due to URTI. **Methods**: A retrospective study was conducted using data from a tertiary hospital in Gaziantep, Turkey, between 2013 and 2023. Patients diagnosed with URTI based on International Classification of Diseases, Tenth Revision (ICD-10) codes were included. Environmental data were obtained from national meteorology and air quality databases. Dust storm days were identified using Aerosol Optical Depth (AOD) values from Aerosol Robotic Network (AERONET) satellite data. Generalized Additive Models (GAM) with negative binomial distribution were used to assess association between environmental variables and URTI visits, adjusting for temporal lag effects and potential confounders. **Results**: A total of 690,608 URTI-related emergency visits were recorded, with 2.4% of days identified as dust storm days. PM10 levels and temperature were significantly higher, pressure and humidity lower, on dust storm days. PM10 was associated with a small but statistically significant increase in URTI visits (Incidence Rate Ratio (IRR) = 1.001, $p < 0.001$), particularly with a 4-day lag (IRR = 1.001, p = 0.029). Increases in temperature and humidity were linked to fewer URTI visits, while increased pressure showed a slight positive association. Dust days themselves had no significant direct association on URTI visits (IRR = 1.006, p = 0.941). **Conclusions**: While desert dust days alter environmental conditions, they do not directly increase URTI-related emergency visits. However, elevated PM10 levels contribute modestly to increased URTI cases, especially with a time-lag effect. Meteorological conditions, particularly higher temperatures and humidity, appear protective, whereas increased pressure slightly elevates URTI risk. These findings highlight the complex and time-dependent nature of environmental influences on respiratory health.

Keywords

Upper respiratory tract infections; Dust days; Temperature; Humidity; Air pollution; Particulate matter

1. Introduction

Acute upper respiratory tract infections (URTI) cause significant loss of productivity and increased healthcare costs in Turkey and around the world [1, 2]. URTI symptoms originate from the upper airway structures above the vocal cords, such as the nose, nasopharynx, oropharynx, and larynx [1, 3]. One or more of the following symptoms may be observed in URTI: sore throat, cough, runny nose, nasal congestion, headache, fever, and fatigue [1, 3]. URTI agents, which can affect all age groups and cause large outbreaks depending on the season, are often viral agents [3, 4]. However, it has been suggested that environmental factors may have a facilitating effect on respiratory tract infections [1, 3, 5, 6].

PM10, PM2.5, pollutant gases (such as sulfur dioxide (SO_2), nitrogen monoxide (NO), carbon monoxide (CO), and ozone (O_3)), air temperature, humidity, and pressure have been identified as risk factors for the development of respiratory diseases [1, 3, 5–7]. Desert dust storms also pose a risk for respiratory diseases due to the high levels of organic and inorganic particulate matter they carry [6, 8]. There is insufficient data on the association of short-term exposure to desert dust storms on URTI.

Due to its geographical location, Turkey is frequently exposed to dust transport events originating from the deserts of Africa and the Middle East [6, 9]. In particular, in the Mediterranean and Southeastern Anatolia regions, this transport periodically causes serious deterioration in air quality [10, 11]. Rapid urbanization, industrialization, and the increase in the number of motor vehicles also increase human-induced air pollution and complicate the relationship between air pollution and respiratory diseases. Although there are some studies in the current literature on the effects of desert dust transport on the respiratory system in Turkey [6], there are insufficient studies examining its association on acute upper respiratory tract infections (URTI).

The aim of this study is to investigate the association of the presence of desert dust days, PM10 levels, daily maximum temperature, humidity, and pressure values on emergency department visits due to URTI.

2. Methods

This study was conducted retrospectively with ethical approval from Gaziantep Islamic Science and Technology University (Date: 05 April 2024, Decision No: 2024-2ÖNP-0110). The study was conducted in accordance with the protocols specified in the Helsinki Declaration.

2.1 Inclusion criteria

In this study, patients who visited the emergency department of a tertiary care hospital in Gaziantep were analyzed. All patients over the age of 18 who presented to the emergency department with upper respiratory tract complaints between 01 January 2013 and 30 December 2023 were included in the study. Patients were screened using the hospital information system based on ICD-10 diagnosis codes. Patients who received the diagnosis codes listed below were included in the study; J00 Acute nasopharyngitis (common cold), J01 Acute sinusitis, J01.0 Acute maxillary sinusitis, J01.1 Acute frontal sinusitis, J01.2 Acute ethmoid sinusitis, J01.3 Acute sphenoid sinusitis, J01.4 Acute pansinusitis, J01.8 Acute sinusitis, other, J01.9 Acute sinusitis, unspecified, J02 Acute pharyngitis, J02.0 Streptococcal pharyngitis, J02.8 Acute pharyngitis, due to other specified organisms, J02.9 Acute pharyngitis, unspecified, J03 Acute tonsillitis, J03.0 Streptococcal tonsillitis, J03.8 Acute tonsillitis, other specified organisms, J03.9 Acute tonsillitis, unspecified, J06 Acute upper respiratory tract infections, multiple and unspecified sites, J06.0 Acute laryngopharyngitis, J06.8 Acute upper respiratory tract infections, other multiple sites, J06.9 Acute upper respiratory tract infection, unspecified.

The visits with missing data in patient records (*e.g.*, age, gender, ICD code) and additional diagnoses other than the specified ICD-10 code were not included in the study.

2.2 Meteorological parameters and detection of particulate matter

Temperature, humidity and pressure values for the specified dates were obtained from the General Directorate of Meteorology. Information on daily PM10 (μg/m^3) values was obtained from the Air Quality Laboratory of the Ministry of Environment and Urbanisation.

2.3 Desert dust storm dates and definition of dust days

To determine the storm dates, satellite images were retrospectively scanned to obtain Aerosol Optical Depth (AOD) values. An AOD value of 500 nm or higher is known to be associated with storms [6, 9]. We identified measurement devices at the Aerosol Robotic Network (AERONET) site located in the Erdemli district of Mersin, the city closest to Gaziantep, at a distance of 241 km, with coordinates: Latitude: 36.56500° North, Longitude: 34.25500° East, Elevation: 3.0 meters (`https://worldview.earthdata.nasa.gov/`).

We accessed AERONET measurements through National Aeronautics and Space Administration's (NASA) data map. However, we saw that the measurements were levelled as 1/1.5/2. Level 1 measurements were unscanned; level 1.5 measurements were cloud-scanned (measurement errors caused by clouds were corrected); and level 2 measurements were cloud-scanned and quality-assured. Level 1.5 measurement data was available on NASA's website, and it was noted that it was not fully reliable. Therefore, to minimize measurement errors and to ensure high data quality, we restricted our analysis to Level 2 AOD data, which are both cloud-screened and quality-assured. This approach reduces the risk of misclassification of dust storm days, although it may lead to a smaller number of identified events. The Level 2 AOD 500 nm values were combined with daily PM10 measurements obtained from the Turkish Air Quality Monitoring System [10].

In this study, "dust days" were identified based on satellite-derived aerosol optical depth (AOD) values obtained from (insert source, *e.g.*, NASA Moderate Resolution Imaging Spectroradiometer (MODIS)). Days with AOD $\geq$0.5 were considered as dust-affected. This threshold was chosen based on previous literature indicating increased atmospheric aerosol load due to desert dust transport [12]. It should be noted that some dust plumes may occur at higher altitudes, especially during long-range transport, and may not result in significantly elevated ground-level PM10 measurements. Therefore, AOD was used as a complementary measure to detect dust presence in the atmosphere, even in cases where PM10 levels remained moderate [12, 13].

2.4 Statistical analysis

This study investigates potential association between PM10 concentrations (particulate matter $\leq$10 μm in diameter), meteorological parameters, and respiratory-related (visits with ICD-10 codes mentioned above) emergency department visits. The data set consisted of daily records obtained from hospital electronic medical records, databases of meteorological and air quality measurement stations and longitudinal observations covering 3448 days. To mitigate potential confounding effects attributable to the SARS-CoV-2 pandemic, data from 21 March 2020 to 15 July 2021, were excluded from analyses. Patient data were aggregated by day and stratified by sex (male, female) and age groups (>65 years, >85 years), with further stratification by sex within each age category.

Multicollinearity diagnostics were performed utilizing Variance Inflation Factor (VIF) methodology, which led to the exclusion of mean meteorological variables (temperature, pressure, humidity) in favor of their respective maximum values to prevent multicollinearity.

The primary analytical framework consisted of Generalized Additive Models (GAM) with negative binomial distribution to account for overdispersion in count data. PM10 concentrations were incorporated as linear terms with temporal lags ranging from 0 to 5 days. The models included dust storm presence as a dichotomous variable (present/absent), along with maximum daily temperature (°C), maximum relative humidity (%), and maximum barometric pressure (mbar) as continuous covariates. The outcome variable was defined as the total daily emergency department visits with specific diagnosis codes (ICD codes mentioned above) related to respiratory symptoms. Separate models were constructed for nine outcome variables: total patient counts, sex-stratified counts, and age-stratified counts (>65 years and >85 years, further subdivided by sex). Effect estimates were expressed as Incidence Rate Ratios (IRRs) with corresponding 95% confidence intervals.

Descriptive statistics were presented as median values with interquartile ranges (25th–75th percentiles). Comparative analyses between days with and without dust days were conducted utilizing non-parametric Mann-Whitney U tests for continuous variables. The proportions of elderly patients (>65 years and >85 years) among total emergency department visitors were calculated and analyzed similarly. Model adequacy was evaluated through assessment of overdispersion parameters (Pearson χ^2/df ratio) and percentage of deviance explained. All statistical procedures were executed using R statistical software (version 4.x.x, R Foundation for Statistical Computing, Vienna, Austria) with specialized packages for data manipulation (dplyr, tidyr), multicollinearity assessment (car), and generalized additive modeling (mgcv). Statistical significance was set at $p < 0.05$ for all analyses.

3. Results

A total of 3448 days were examined. Of these, 2.4% (82 days) were dust storm days, while 97.6% (3366 days) were normal days. The total number of patients was 690,608, of whom 53.7% were male (370,676 people) and 46.3% were female (319,932 people). The average PM10 level was 49.475 μg/m^3, the maximum temperature was 23.1 °C, the maximum humidity was 71%, and the maximum air pressure was 917.9 mbar (Table 1).

On days with dust days, the average PM10 level was 58.805 μg/m^3, while on days without dust days, it was 49.245 μg/m^3 (p = 0.003). The maximum temperature was 32.7 °C on dust storm days and 22.75 °C on non-storm days ($p < 0.001$). The humidity level was 62% on dusty days and 72% on non-dusty days ($p < 0.001$). Air pressure was 913.8 mbar on dust storm days and 918 mbar on non-dust days ($p < 0.001$) (Table 2).

As daily maximum temperature increased, a decrease in URTI visits was observed (IRR = 0.974, $p < 0.001$). A decrease in URTI visits was also observed as daily maximum relative humidity increased (IRR = 0.989, $p < 0.001$). A slight increase in URTI visits was observed as daily maximum air pressure increased (IRR = 1.010, p = 0.007). No significant effect of dust days on URTI visits was detected (IRR = 1.006, p = 0.941) (Table 3).

A slight increase in total URTI visits was observed as PM10 levels increased (IRR = 1.001, $p < 0.001$). The effect of PM10 levels at lag2, and lag3 was not statistically significant. A slight increase in visits was observed at lag1 and lag4 (IRR = 1.002, $p < 0.001$ & IRR = 1.001, p = 0.029) (Table 4).

4. Discussion

Atmospheric gases inhaled during respiration, various environmental pollutants such as volatile and non-volatile particulate matter, contribute to the development of infection by disrupting the mucosal functions of the upper respiratory tract [11]. On the other hand, it is assumed that meteorological factors such as temperature, humidity, and pressure modulate viral pathogens by affecting their surface proteins, lipid membrane properties, and stability [14]. There are many studies in the literature examining the effects of all these atmospheric changes and air quality on URTI [15, 16]. However, no studies have been conducted on the effects of desert dust, which degrades air quality on days when dust transport occurs, on URTI.

In a study in Turkey where the five-year data of 5,279,033 patients were retrospectively analysed, the most common reason for emergency department visits was upper respiratory tract diseases [2]. In this study, which did not consider air pollution, air quality, and meteorological factors, most of the hospital visits due to URTI were women [2]. Studies that take into account atmospheric changes caused by pollutants such as particulate matter (PM) and nitrogen dioxide (NO_2), SO_2 have found that both women and men are predominantly affected [1, 17]. In our study, 53.7% of those who visited the hospital were men.

Most URTI cases are related to air temperature and occur seasonally in cold weather [5]. Temperature changes can directly affect the development of respiratory tract infections by influencing inflammatory pathways or pathophysiological responses, such as vasoconstriction of the mucous membrane and suppression of the immune system [5]. Temperature changes can indirectly affect pathogen transmissibility and survival time in the open air, which are virulence factors [5]. Viruses, especially enveloped viruses, maintain their integrity better at low temperatures, while at high temperatures the envelope becomes irregular and the virus becomes more susceptible to damage [18]. Therefore, meteorological factors such as temperature and humidity have a significant effect on the incidence of common cold pathogens and can influence virulence through meteorological factors. There are numerous studies in the literature on the increased incidence of URTI and its causative agents, particularly at low temperatures [7, 19]. In line with these studies, our findings also show a decrease in URTI cases as temperature increases.

TABLE 1. Patient demographics and daily environmental measurements during the study period.

Parameter	Value
Total Days (n, %)	3448 (100.0%)
Dust Storm Days	82 (2.4%)
Non-Dust Days	3366 (97.6%)
Total patients (n, %)	690,608 (100.0%)
Male	370,676 (53.7%)
Female	319,932 (46.3%)
Age (yr) (median, q1–q3)	29 (18–42)
PM10 lag0 (μg/m^3) (median, q1–q3)	49.475 (34.4900–74.6575)
Max Temperature (°C) (median, q1–q3)	23.1 (13.900–32.325)
Max Relative Humidity (%) (median, q1–q3)	71 (56–88)
Max Air Pressure (mbar) (median, q1–q3)	917.9 (914.1–921.7)

μg: microgram; mbar: millibar; Max: maximum; PM: particulate matter.

TABLE 2. Data for stormy and non-stormy days.

Parameter	Dust days	Non-Dust Days	*p* value
Number of the days (n, %)	82 (2.4%)	3366 (97.6%)	
PM10 lag0 (μg/m^3) (median, q1–q3)	58.805 (39.350–91.020)	49.245 (34.3825–74.5275)	0.003
Max Temperature (°C) (median, q1–q3)	32.70 (24.575–36.575)	22.75 (13.700–32.100)	<0.001
Max Relative Humidity (%) (median, q1–q3)	62 (52.25–71)	72 (56.00–88)	<0.001
Max Air Pressure (mbar) (median, q1–q3)	913.8 (912.15–917.175)	918.0 (914.20–921.80)	<0.001

μg: microgram; mbar: millibar; Max: maximum; PM: particulate matter.

TABLE 3. Effect of environmental parameters on the number of URTI applications.

	Max Temperature (°C)		Max Relative Humidity (%)		Max Air Pressure (mbar)		Dust Storm Present	
	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value
All Sexes								
Total	**0.974 (0.970–0.978)**	**<0.001**	**0.989 (0.986–0.991)**	**<0.001**	**1.010 (1.002–1.017)**	**0.007**	1.006 (0.841–1.204)	0.941
>65	**0.976 (0.971–0.980)**	**<0.001**	**0.989 (0.987–0.992)**	**<0.001**	1.005 (0.997–1.013)	0.166	1.050 (0.861–1.280)	0.626
>85	**0.984 (0.973–0.995)**	**0.005**	**0.991 (0.986–0.997)**	**0.003**	1.007 (0.989–1.026)	0.404	1.226 (0.738–2.038)	0.430
Male								
Total	**0.973 (0.968–0.977)**	**<0.001**	**0.989 (0.986–0.991)**	**<0.001**	**1.010 (1.003–1.018)**	**0.005**	0.983 (0.821–1.177)	0.856
>65	0.977 (0.972–0.982)	<0.001	**0.990 (0.987–0.992)**	**<0.001**	**1.010 (1.002–1.019)**	**0.015**	1.017 (0.862–1.333)	0.526
>85	0.985 (0.968–1.002)	0.100	0.992 (0.984–1.002)	0.099	1.013 (0.985–1.042)	0.351	1.180 (0.526–2.645)	0.687
Female								
Total	**0.975 (0.971–0.979)**	**<0.001**	**0.989 (0.986–0.991)**	**<0.001**	**1.009 (1.002–1.016)**	**0.012**	1.032 (0.861–1.238)	0.727
>65	**0.974 (0.969–0.979)**	**<0.001**	**0.989 (0.986–0.991)**	**<0.001**	1.000 (0.992–1.009)	0.831	1.030 (0.835–1.272)	0.778
>85	**0.984 (0.971–0.997)**	**0.016**	**0.991 (0.984–0.997)**	**0.008**	1.007 (0.985–1.029)	0.524	1.247 (0.678–2.291)	0.476

μg: microgram; mbar: millibar; Max: maximum; IRR: Incidence Rate Ratio. The bold ones are the ones with significant results; the p-values are also written in bold for this reason.

TABLE 4. Lag effects of PM10 values.

	PM10 Lag0		PM10 Lag1		PM10 Lag2		PM10 Lag3		PM10 Lag4		PM10 Lag5	
	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value	IRR	*p*-value
All Sexes												
Total	**1.001 (1.000–1.002)**	<**0.001**	**1.002 (1.001–1.003)**	<**0.001**	1.001 (0.999–1.002)	0.371	1.000 (0.999–1.002)	0.302	**1.001 (1.000–1.002)**	**0.029**	1.000 (1.000–1.001)	0.324
>65	**1.001 (1.000–1.002)**	<**0.001**	1.000 (0.999–1.001)	0.861	1.001 (1.000–1.002)	0.134	1.000 (0.999–1.002)	0.453	**1.001 (1.000–1.003)**	**0.017**	1.000 (0.999–1.001)	0.353
>85	1.001 (0.999–1.003)	0.395	0.999 (0.996–1.001)	0.347	1.002 (0.999–1.004)	0.192	1.002 (0.999–1.004)	0.158	1.001 (0.999–1.004)	0.322	1.002 (0.999–1.003)	0.216
Male												
Total	**1.002 (1.001–1.003)**	<**0.001**	1.001 (0.999–1.002)	0.330	1.001 (0.999–1.002)	0.334	1.000 (0.999–1.002)	0.304	**1.001 (1.000–1.002)**	**0.027**	1.001 (1.000–1.002)	0.241
>65	**1.001 (1.000–1.002)**	**0.041**	1.000 (0.999–1.001)	0.921	1.001 (0.999–1.002)	0.297	1.000 (0.999–1.002)	0.477	1.002 (1.000–1.003)	0.007	1.001 (1.000–1.002)	0.278
>85	0.998 (0.994–1.002)	0.441	1.000 (0.996–1.004)	0.930	1.002 (0.999–1.006)	0.208	1.002 (0.998–1.005)	0.291	1.001 (0.997–1.004)	0.717	1.003 (1.000–1.006)	0.080
Female												
Total	**1.002 (1.001–1.003)**	**0.001**	1.000 (0.999–1.002)	0.428	1.001 (0.999–1.002)	0.307	1.000 (0.999–1.001)	0.812	**1.001 (1.000–1.002)**	**0.003**	1.000 (0.999–1.001)	0.466
>65	**1.002 (1.001–1.003)**	**0.003**	1.000 (0.999–1.001)	0.815	1.001 (1.000–1.002)	0.094	1.000 (0.999–1.002)	0.489	1.001 (1.000–1.002)	0.058	1.000 (0.999–1.001)	0.609
>85	1.002 (1.000–1.005)	0.085	0.998 (0.995–1.001)	0.215	1.001 (0.998–1.004)	0.451	1.002 (0.999–1.004)	0.301	1.002 (0.999–1.005)	0.286	1.000 (0.998–1.003)	0.810

IRR: Incidence Rate Ratio; PM: particulate matter. The bold ones are the ones with significant results; the p-values are also written in bold for this reason.

In addition to temperature, meteorological factors such as humidity and relative humidity have a significant effect on the incidence of common cold pathogens, and changes in meteorological factors can potentially affect virulence [19]. In a review conducted by Hyrkäs-Palmu and colleagues in 2025, 14 studies were examined, and the effect of atmospheric humidity on URTI was found to be negative in 5 studies, positive in 3 studies, and ineffective in 6 studies [7]. In our study, we observed a decrease in URTI visits as maximum relative humidity increased on days with dust days.

Studies have been conducted on the effects of climate factors (temperature, dew point, precipitation), including barometric pressure, on human health [20]. In a study investigating the relationship between PM10 and meteorological factors in Malaysia, hospital admissions for respiratory diseases were found to have a strong negative correlation with barometric pressure [21]. On the other hand, there are also studies showing that changes in atmospheric pressure in children are associated with increases and decreases in respiratory syncytial virus (RSV) activity [22]. Li and colleagues demonstrated a statistically significant correlation between the weekly number of outpatient visits related to influenza A and the weekly average barometric pressure in temperate regions such as Shanghai (China) [23]. In our study, we also found a significant relationship between air pressure and URTI visits, consistent with the literature. Accordingly, a slight increase in URTI visits was observed as air pressure increased.

Some studies conducted in Iran have shown increases in hospital admissions and cardiovascular deaths due to respiratory infections during dust storms [24]. Similarly, studies conducted in Turkey have also shown a positive correlation between dust storms and emergency department visits and mortality rates for asthma, Chronic Obstructive Pulmonary Disease (COPD), cardiovascular diseases, and stroke patients [6, 25, 26]. During the COVID-19 pandemic, a relationship between transmission, hospitalisation, and mortality was observed on stormy days, while in China, desert dust storms were found to increase outpatient visits related to tuberculosis [24]. In our study, unlike the studies in the literature, we could not detect a significant relationship between dust days and URTI visits. We believe that this situation can be explained by the fact that viral upper respiratory tract infections, which develop more at lower temperatures, are less common on hot days when desert dust days occur. In this study, satellite-based AOD data and local PM10 measurements were used together to identify desert dust transport days. However, it was observed that the daily PM10 averages were well below the classic dust storm values (1000–5000 μg/m^3). This is an important limitation of our study and suggests that the exposure obtained may represent more mild-to-moderate transport days. Therefore, the absence of a significant increase in PM10 levels may have contributed to the lack of expected noticeable effects on emergency department visits.

In a meta-analysis evaluating outdoor particulate matter exposure and upper respiratory tract infections, Ziou M and colleagues found some evidence of an association between PM and URTIs in children and adolescents, with the strength of the association increasing with PM10 [11]. Additionally, a study conducted in 13 Southern European cities reported that increases in PM10 concentrations were associated with higher risks of mortality and respiratory hospital admissions [27]. Similar results were also demonstrated in studies conducted by Jia and colleagues in Shenzhen, China, and by Nascimento and colleagues in Brazil. Both studies showed that hospital admissions due to respiratory diseases increased as PM10 concentrations rose [5, 17]. In China, a positive correlation was also found between children's respiratory syncytial virus (RSV) infection rates and PM10 concentrations. It has been reported that the deeper penetration of RSV into the respiratory system is supported by particle-based transport [24]. Similar results have been shown in other studies [24, 28]. The results we obtained in our study are consistent with these studies, and an increase in total URTI visits was observed as PM10 levels increased.

In a study conducted in Malaysia in 2024, which evaluated 19 years of data, the lag effect of PM10 on respiratory diseases was investigated, and the impact on hospital admissions was found to persist for up to 30 days, with the strongest association observed at lag0 and lag6 [21]. Similarly, a study by Nascimento *et al*. [17] examining the relationship between PM10 and respiratory diseases reported increased hospital admissions on days 0 and 6 following exposure. In our study, we also observed a slight increase in URTI-related emergency visits on day 4 following PM10 exposure (lag4), consistent with previous findings. Although the association between PM10 and URTI visits reached statistical significance, the effect size was minimal (IRR = 1.001), indicating limited clinical significance despite the large sample size.

5. Limitations of the study

One of the main limitations of our study is that it is single-centred. Since this study is single-centered and observational in design, the findings cannot be directly generalized to the general population; the results should only be interpreted for the relevant hospital population. However, it is the largest and busiest hospital in the city. It should be borne in mind that there may be a large number of patients with URTI symptoms who do not visit the emergency department but instead visit family health units. The use of retrospective and secondary data is another limitation of the study. The limited number of desert dust days based on working hours is a significant constraint that reduces the accuracy of estimates of the effects of this exposure. In addition, the exclusion of Level 1 and 1.5 AOD measurements may have resulted in underestimation of milder dust events.

High AOD values may not always correspond to high surface PM10 concentrations. In particular, dust particles passing through the upper troposphere may not reach the ground but only affect the upper atmosphere. Therefore, PM10 levels may remain low on some dusty days [12, 13].

6. Conclusions

The negative effects of climate change on human health as a result of global warming are increasing day by day. This study shows that environmental parameters change significantly on dust storm days, but dust days have no significant association on upper respiratory tract infection visits. An increase in PM10 levels was associated with a slight but significant increase in URTI visits, with this effect becoming particularly evident on the fourth day (lag4). Increases in maximum temperature and relative humidity were associated with a decrease in URTI visits, while increases in air pressure led to a slight increase in visits. Our findings suggest that air pollution parameters may have time-dependent effects on URTI, but dust days alone are not a decisive factor.

AVAILABILITY OF DATA AND MATERIALS

Submitted work is original and has not been published elsewhere in any language. The raw data supporting the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

KEA, MMO—created the idea of the study, carried out statistical analyses, contributed to the analysis of the data and supported the interpretation of the results. BB, HTH—conceived the idea of the study, designed the study, coordinated the collection of data and managed the writing process of the manuscript. MTÖ—actively contributed to data collection, conducted the literature review and took part in the manuscript writing process. SK—took part in data collection, made clinical interpretations and contributed to the revisions of the manuscript. MB—contributed to the conduct of the study, assisted in the clinical interpretation of the findings and supported the manuscript writing process. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics committee approval was obtained from the local ethics committee (Date: 05 April 2024, Decision No: 2024-2ÖNP-0110). Authors declare that human rights were respected according to the Declaration of Helsinki. The requirement for informed consent was waived by the Gaziantep Islamic Science and Technology University Ethics Committee.

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