

Effects of Particulate Air Pollution on Emergency Department Visits for Headache as Chief Complaint

Aylık acil servis primer başağrısı başvurularında hava kirliliğinin etkisi

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SUMMARY

Objective: Particulate air pollution is a mixture of solid, liquid, or solid and liquid particles suspended in the air. There have been abundant studies on the short-term effects of air pollution on health, with emphasis on mortality and hospital admissions. Here we propose to assess the relationship between ambient air pollution, and monthly emergency department (ED) visits for headache. In the present study, the objective was to examine the relationship between monthly ED visits for headache and selected particulate air pollution factors.

Methods: This was a retrospective study of 257 ED visits for headache (ICD-10: G43 and G44) recorded at Ege University hospital between June 2008 and May 2009 (12 month). Measured air pollutants included sulfur dioxide (SD), suspended particulate matter (PM), and carbon monoxide (CO). Conditional logistic regression was used to estimate the effects of particulate air pollution factors.

Results: We found no association between outdoor measures of carbon monoxide, sulfur dioxide and headache visits to ED. Statistically significant positive associations were observed between the number of ED visits for headache and the suspended particulate matter (PM10), ($p=0.008$ Spearman's rho).

Conclusion: An increase in levels of pm10 is associated with an increase in the number of ED visits for headache. Presented findings verify that ED visits for headache are correlated to particulate air pollution.

Key words: Air pollution; emergency department visit; headache.

ÖZET

Giriş: Hava kirliliği, canlıların sağlığını olumsuz yönde etkileyen, havadaki katı ya da yabancı maddelerin birleşiminin, normalin üzerindeki miktar ve yoğunluğa ulaşmasıdır. Yapılan birçok çalışmada, hava kirliliğinin mortalite ve hastaneye başvurular üzerindeki kısa dönem etkilerinin önemi vurgulanmıştır. Bu çalışmanın amacı, hava kirliliğine bağlı olarak, aylık acil servis başağrısı başvuruları arasında ilişki olup olmadığını değerlendirmektir.

Gereç ve Yöntem: Yapılan bu retrospektif çalışmada, Haziran 2008 ve Mayıs 2009 tarihleri arasındaki 12 aylık periyotta acil servise başvuran ve tanısı primer başağrısı (ICD kod:G43 ve G44) olan 257 hasta değerlendirildi. Ulusal hava kalitesi izleme ağından elde edilen hava kirliliği parametreleri olan hava asılı partiküller materyaller, kükürtdioksit ve karbonmonoksit ölçümlerinden elde edilen değerler ile aylık acil servis primer başağrısı başvuru sayısı arasındaki ilişki lojistik regresyon analizi ve lineer korelasyon ile incelendi.

Bulgular: Dış çevre ölçümlerinden elde edilen kükürtdioksit ($p=0,376$) ve karbonmonoksit ($p=0,196$) değerleri ile acil servise başvuran primer başağrılı hasta sayısı arasında istatistiksel olarak anlamlı bir ilişki olmadığı görüldü. Bununla birlikte havada asılı partiküller materyal ölçümleri (PM10) ile başvuran hasta sayısı arasında istatistiksel ilişki anlamlı olarak yüksek bulundu ($p=0.008$ spearman rho).

Sonuç: Dış ortamdaki hava kirliliğine neden olan, havada asılı partiküller materyallerin (PM10) artması, acil servise başvuran primer başağrılı hasta sayısını arttırmaktadır. Elde edilen bulgular, hava kirliliğinin acil servise başvuran primer başağrılı hasta sayısını arttırdığını destekler niteliktedir.

Anahtar sözcükler: Hava kirliliği; acil servis başvuruları; başağrısı.

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Introduction

Air pollutants are heterogeneous mixture of gaseous and particulate matter. The main gaseous components of air pollution include nitrogen oxides (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO), carbonyl compounds, and organic solvents. Particulate matter (PM), on the other hand, is made up of solid and liquid particles coming from several sources such as vehicle emissions, industrial and domestic emissions, forest fires, cigarette smoke, natural trees, and climate variations.^[1] The sizes of these particles are subdivided into several groups depending on their diameter. If the particle diameter is less than 10 micrometer, it is called PM10.^[2] Recent studies have shown that exposure to environmental air pollutants is a major cause of increase in hospital admissions for cardiovascular diseases^[3,4] and asthma.^[5]

On the other hand, migraine headache is a common clinical problem, an important cause of morbidity. Migraine triggers include weather, fatigue, stress, food, menstruation, and infections. Air quality in the home, office environment, and occupational setting may play a role in the exacerbations of migraine headache.^[6] The purpose of the present study was to assess the relationship between outdoor air pollution and emergency visits for migraine and other primary headache disorders in Izmir, Turkey.

Materials and Methods

The number of emergency department (ED) visits for migraine and other primary headache disorders was collected through records of the Ege University Emergency Medicine Department from June 1, 2008 to May 31, 2009 on a monthly basis. The ED visits for headache were identified based on a discharge diagnosis of migraine and other primary headache disorders using the International Classification for Diseases, (ICD-10, G43 and G44). There was a total of 257 ED visits for migraine and other primary headache disorders during the study period. The time and date of presentation, and demographic features were also extracted from ED records. Air pollution data were obtained from the automated fixed-site continuous monitoring stations maintained as a part of the National Air Quality Monitoring system. In Izmir, there were seven such monitoring stations in operation during the study period. For each site, daily mean and maximum pollution levels were constructed from hourly mean values. Daily data of air pollutants included SO₂ (in pbb), suspended particu-

late matter (PM10; in µg/m³), and CO (X 0.1 in parts per million). The mean values of monthly measurements obtained from the monitors that are placed in city centers were used for data analysis for each pollutant. CO measurements were not evaluated only for one month, since monitoring of these substances was not conducted at the time of this study. Data analysis was performed with the SPSS 14.0 for Windows Software Package (SPSS, Chicago, Ill). Associations between outdoor air pollution and ED visits for migraine and other primary headache disorders were formally investigated using statistical methods of linear regression and linear correlation model.

Results

Total number of ED visits for adults due to migraine and primary headache disorders in each month and distributions of the monthly mean air pollutant concentrations (SO₂ and PM10) during June 2008 and May 2009, are presented in Fig. 1 and Fig. 2 respectively. The monthly mean air CO concentrations during study period are presented in Fig. 3. Most of the variation in air pollutant concentrations was seen in PM10, SO₂ and CO concentrations during spring and autumn. The cumulative monthly number of ED visits for migraine and other primary headache disorders every month was compared with the corresponding cumulative mean of each of the air pollutants. The monthly mean values of the air pollution concentration levels were used to represent the shared exposure for the population in the study. Significant ($p \leq .05$) positive correlations were found between ED visits for migraine and other primary headache disorders and the mean ambi-

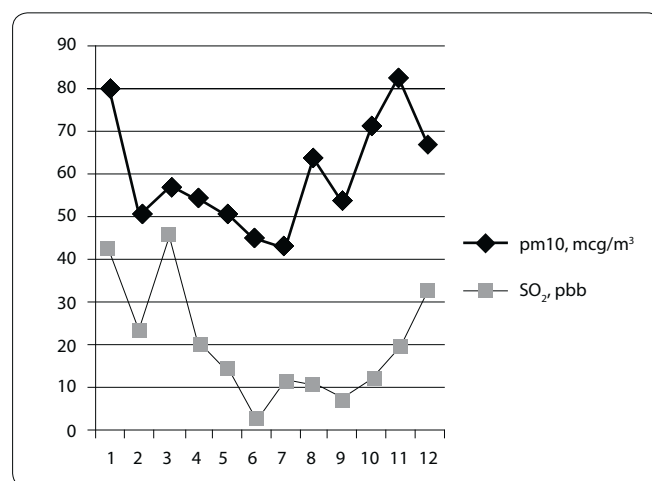


Fig. 1. Monthly mean values of particulate matter and sulphur dioxide concentrations.

ent concentrations of PM10 ($p= 0.008$, Spearman’s rho), in the study group.

In this study, no significant correlation was found between monthly mean values of the CO ($p= 0.196$), and SO₂ ($p= 0.376$) levels and the patients with primary headache complaints admitted to the ED in the same time interval.

Significant associations were found between PM10 and monthly number of ED visits for migraine and other primary headache disorders with value of $R^2 = \%46,8$ ($p= 0.014$).

Discussion

It is well known that exposure to high levels of air pollution can adversely affect human health. There is a large number of studies on the short-term health effects of air pollution, with the emphasis on mortality and hospital admissions.^[7] Air pollution, is becoming one of the most

important health problems these days. One reason is that, although air pollution from combustion of traditional fossil fuels is now present in much lower concentrations than it is 50 years ago, oxides of nitrogen produced by the ever-rising number of motorized vehicles have increased until recently.^[8] Interest in health effects of air pollution became more intense after some cohort studies suggested that exposure to fine particulate matter in the air was associated with life shortening.^[9] For millions of people living in rural areas in developing countries, indoor pollution from the use of biomass fuels occurs at concentrations that are orders of magnitude higher than currently seen in the developed world.^[10] Particulate air pollution is a mixture of solid, liquid, or solid and liquid particles suspended in the air. The size of suspended particles varies, from a few nm to tens of micrometer. In practical terms, a distinction is made between PM10 (“thoracic” particles smaller than 10 micrometer, in diameter that can penetrate into the lower respiratory system), PM2,5 (“respirable” particles smaller than 2,5 micrometer, that can penetrate into the gas-exchange region of the lung).^[8] It has been suggested that after inhalation exposure ultrafine particles may translocate into the blood stream and can be found in remote organs.^[11] Increased concentration of C-reactive protein is a biomarker of systemic inflammation. In human studies, exposure to particulate air pollutants increased circulating levels of C-reactive protein and other inflammatory markers, increased blood coagulability, caused endothelial dysfunction and acute vasoconstriction.^[12,13] Spatial differences in exposure to particulate matter have also been associated with carotid intima-media thickness, and exposure to carbon monoxide (CO) has been shown to decrease the ability of blood to carry oxygen.^[14] These combined effects may in increase the risk of activate a primary headache.

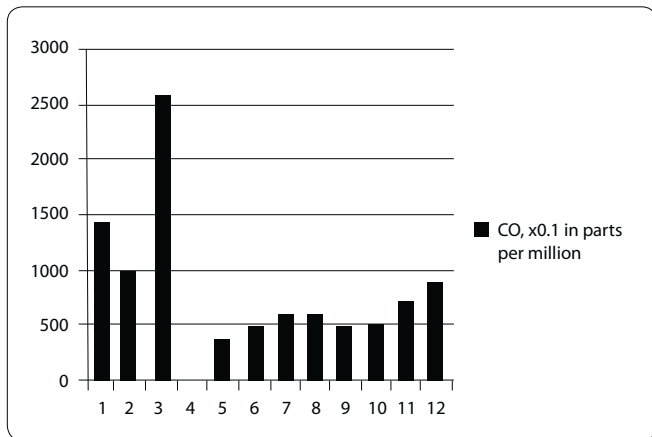


Fig. 2. Monthly mean values of carbon monoxide levels.

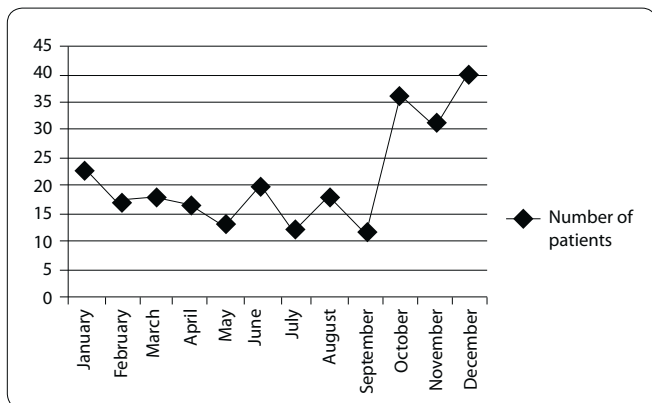


Fig. 3. Frequency of ED Visits for Headache, seen each month in the ED.

Literature on the possible relationship between headaches induced by PM10 air pollution is still limited. Some studies have confirmed that an increase of SO₂^[6] and SO₂, NO₂, CO, and PM2.5, results in an increased the number of ED visits for headache.^[15] Our study summarizes the relationship between air pollution and ED visits for migraine and other primary headache disorders in Izmir over a 1-year period. These analyses suggest that exposure to particulate air pollution is associated with increased risks for admission headache, and that these visits increased during winter months. The vascular hypothesis of migraine has been superseded by a more integrated theory that involves

both vascular and neuronal components. Neuronal event may also activate perivascular nerve afferents, leading to vasodilation and neurogenic inflammation of the meningeal blood vessels and, thus, causing throbbing pain.^[16] Airway cooling and particulate air pollution might contribute to neurogenic inflammation and trigger of primary headaches.

There were some limitations in our study. First, this was a retrospective study and inclusion was completely dependant on the final ICD-code of the recording data. Second, some adults with headache may not go to the ED for a headache attack, but instead they may prefer to self-treat with a non-steroid antienflamatory or other medications at home. Then again only outdoor exposures were assessed, although personal exposure to some pollutants such as CO, NO₂ also occurs indoors at levels sometimes higher than those found outdoors with smoking, living in intense traffic area and burning of poor quality coal and fuel. Occupational exposures, emotional factors, and systemic diseases are other contributory factors not evaluated in our study.

Conclusion

An increase in levels of PM₁₀ is associated with an increase in the number of ED visits for headache. Presented findings verify that ED visits for headache are correlated to particulate air pollution.

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