

Policy Brief

A Critique of Studies on the Combined Effect of Dust Storms and Meteorological Elements on Cardiovascular, Cerebrovascular, and Respiratory Diseases



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Brief Policy

The studies reviewed in this section are from PubMed, International Statistical Institute (ISI), ScienceDirect, Google Scholar, and Scopus databases using the following keywords, including dust storm, meteorological elements, temperature, heat wave, cold wave, relative humidity, wind blow, atmospheric pressure, cardiovascular diseases, respiratory diseases, cerebrovascular diseases, Myocardial Infarction (MI), Cerebrovascular Accident (CVA), lung diseases, health, brain events, heart events, heart attack, Coronary Artery Diseases (CAD), acute coronary symptoms (ACS), ischemic heart disease (IHD), Congestive Heart Failure (CHF), chronic diseases, and Chronic Obstructive Pulmonary Diseases (COPD). The study was conducted using the combined strategy of and, or, and not statements.

Reviewing and criticizing studies related to the effects of dust storms

A retrospective cohort study was conducted by Ebrahimi et al on the effect of dust storm events on the emergency hospitalization of cardiovascular and respiratory patients in Sanandaj City, Iran, to evaluate the possible

consequences of dust storms on the occurrence of cardiovascular and respiratory diseases in the residents of Sanandaj City. Dust storm events were calculated based on the definition of the environmental protection agency and the announcements of the meteorological organization from March 21, 2009 to June 21, 2010. Information about dust incidents related to cardiovascular and respiratory diseases was obtained from Sanandaj medical emergency and disaster center. Particulate Matter (PM) 10 concentration and air quality data were obtained from the air quality monitoring agency of the general director of environmental protection of Kurdistan Province, Iran. The results of this study show a significant increase in emergency admission for cardiovascular and respiratory diseases in periods associated with dust storms in Sanandaj City. Although the relationship between respiratory diseases and dust storms was statistically insignificant, the number of cardiovascular diseases was significantly related to it [1].

Considering the effects of dust storms on cardiovascular and respiratory diseases, this study is consistent with some of the study's objectives. Insignificant impacts of dust storms on respiratory diseases contradict some other studies. To obtain more accurate results, it is better to

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conduct a survey over a longer period and consider the concentration of PM_{2.5} particles.

In a retrospective cohort study conducted by Ansari et al, the relationship between meteorology and health risk assessment using AirQ⁺ software with environmental fine particles in Tehran City, Iran, to correlate between fine particles (PM_{2.5}) and meteorological variables and annual estimation of mortality from cerebrovascular disease (stroke), Ischemic Heart Disease (IHD), Acute Lower Respiratory Tract Infection (ALRI), Lung Cancer (LC), Chronic Obstructive Pulmonary Disease (COPD) due to long-term exposure to PM_{2.5} was examined in Tehran City from March 2017 to March 2018 using WHO AirQ⁺ software. Data related to air quality, meteorological conditions, population, and infection rates in Tehran City were collected from government organizations. The results of this study showed that with an increase of one microgram per cubic meter of PM_{2.5}, it is predicted that about 27 cases will be added to the deaths caused by air pollution in Tehran City [2].

It is better to conduct a study over a longer period to obtain more accurate results. Considering that most of the particles in dust storms are of mineral type, the results of this study will be comparable to this study.

Yang Tan conducted a retrospective cohort study based on ecological data in Taiwan to investigate the relationship between dust storms and coronary artery disease. He examined about 143 thousand cases between 2000 and 2009 regarding heart diseases and compared them with the concentration of dust in the air on the patients' hospitalization date. The results showed a significant relationship between acute heart attacks and dust storms. This relationship indicates that 3 days after the dust storm in Taiwan, the number of acute heart attacks increased significantly [3].

This study is essential because it did not satisfy with examining dusty days and considered the days after dusty days, and it is somewhat similar to the objectives of this study.

In a retrospective cohort study conducted by Vedonos in the United States to determine the relationship between dust and cardiac mortality, the records of 1 000 heart patients aged over 18 hospitalized between 2001 and 2010 were examined and correlated with the amount of dust on the days of the year so that the results showed a high correlation between the amount of dust and coronary artery diseases [4].

Considering that many studies refer to the long and sometimes late effects of dust storms, even days without the occurrence of dust storms may have affected patients from previous dust storms, so this study is seriously biased.

A descriptive-analytical study was conducted by Ueda et al entitled "Asian long-range dust and the number of prehospital emergency operations", showing that Asian Dust storms (AD), transported from their sources, lead to the sharp increase in rough, and pointed coarse particles in Japan. The association of exposure to AD incidents with emergency ambulance dispatch in Nagasaki City was investigated. From March to May 2003-2007, 9 070 dispatches existed. The results showed that exposure to high levels of AD particles can increase the dispatch of emergency ambulances due to diseases, such as cardiovascular stress. The ability of AD particles to settle at different height levels may have other health effects [5].

The point to be considered in this study is that the type, size, geometric shape, fine, and coarse particles in dust storms and the placement of those particles at different height levels can have other effects on heart diseases.

Kashima et al. in a time-series study titled "the impact of AD on mortality caused from specific causes in five cities in South Korea and Japan" stated that desert dust appears to be potentially toxic and can be changed during long-range transport. The combined effects of all causes and the main cause of death from Asian dust events were evaluated in five densely populated cities of South Korea (Seoul) and Japan (Nagasaki, Matsu, Osaka, and Tokyo). This study showed negative health effects and increased mortality caused by all causes, and cerebrovascular diseases in Korea and Japan. However, the impacts of Asian dust were different in cities, and its adverse effects were more evident in cities close to the sources of Asian dust [6].

The results of this study show that dust storms affect all kinds of diseases, including cerebrovascular diseases, which is one of the questions of this research. The critical point is the change in the toxic effects of dust storms with the distance of cities from the sources of these storms.

In a retrospective cohort study by Barnett et al. titled "effects of the 2009 dust storm on emergency hospitals in Brisbane, Australia", the levels of PM₁₀ particles were 894 µg/m³ and PM_{2.5} were 138 µg/m³. These levels were far more than the standards defined in Australia. This situation continued for 10 days. And it reached the highest level on September 26 due to the secondary storm. Horizontal visibility during the day in this storm was 5 km. Due to increased wind

speed, the humidity in the atmosphere dropped drastically. The results showed an increase in the admission of patients to the emergency department on days with dust events. However, increasing particle diameter did not play a role in increasing admission [7].

The results of this study show that dust storms affect the admission of patients to the hospital, which is one of the questions of this study. In many studies, the particle diameter is involved in the toxic effects of dust storms, but the results of this study contradict this opinion. On the other hand, the drop in humidity in the atmosphere is mentioned! However, the health impact of this drop in moisture has not been investigated. This study is designed to answer these questions.

Another retrospective cohort study published by Bennett et al examined the impact of the 1998 Gobi dust on emergency hospitalization rate for respiratory and cardiac diseases in the greater Vancouver area. The Vancouver region was compared with dust days from the Gobi region compared to a similar period from the previous year to control for meteorological influences on the side effects of anthropogenic pollution. This preliminary analysis shows that it is difficult to find a causal relationship between the health effects and these storms. Furthermore, despite the presence of the dust incident, no statistically significant effect was observed on hospitalization. The impact of the dust event on hospitalization was statistically similar to days without dust. These data show that the dust from the earth's crust (deserts) is far less dangerous than man-made pollutants, regardless of their size. Little evidence shows that the 1998 tectonic dust event in the Gobi deserts of Asian origin was a significant public health hazard in Northwestern American hospitals [8].

The results of this study are crucial because it shows that dust storms do not affect the admission of patients to the hospital that is in contrast with the results of some other studies. The current research tries to resolve this contradiction. In addition, this study emphasizes the difference between man-made and mineral pollutants caused by the earth's crust, which is also the central point of the current research.

Reviewing the studies related to the effects of meteorological elements

Shcherbakov et al in a retrospective cohort study investigated the ambient temperature and the effects of heat waves on the number of patients hospitalized in California hospitals from 1999 to 2009 and showed how heat waves or incremental temperature changes affect health

outcomes. However, few studies have examined both simultaneously. The possible effects of single temperature and heat waves in hospitals in 16 climate zones across California from May to October 2009-1999 were investigated. Finally, the results prove that heat waves and temperature exposure can independently affect various cardiovascular, respiratory, and brain diseases [9].

The results of this study refer to the independent effects of different temperature ranges and heat waves on cardiovascular, respiratory, and cerebrovascular diseases. In addition to clarifying this issue, this study aims to determine the combined effects of the temperature spectrum, dust storms, and other meteorological elements.

In a systematic review and meta-analysis titled "general cold wave dependence and health side effects," Nilo et al. showed substantial evidence that mortality is increased at low temperatures. The role of prolonged periods of cold, known as cold waves, has received less attention. The results showed that the cold wave is associated with an increased death rate in the surrounding population. The evidence indicates that the cold wave has other negative effects on health [10].

The results of this study indicate the effects of cold and heat waves on mortality. This study aims to investigate the impact of different temperature spectrums, alone and combined with dust storms and other meteorological elements on the incidence of cardiovascular, respiratory, and cerebrovascular diseases.

Son et al in a retrospective cohort study titled the effect of temperature, cold, and heat waves on hospitalization rate in eight Korean Cities showed that although the effect of temperature on mortality is well documented, relatively fewer studies have been conducted on the relationship between temperature and outcomes, such as hospitalization. Climate and hospitalization due to certain factors (allergic disease, asthma, selected respiratory disease, and cardiovascular disease) were investigated in eight major cities in Korea from 2003 to 2008. Also, the possible effect of individual characteristics, such as gender and age was homogenized. The results showed that vulnerable populations, such as women and younger people are more affected. Research results proved that high and low ambient temperatures are associated with the risk of hospitalization in Korea, especially in women and young people [11].

The results of this study refer to the effects of different temperature ranges, cold waves, and heat waves on hospitalization due to allergic diseases, respiratory diseases,

and cardiovascular diseases. While, this study aims to investigate the effect of different temperature spectrums, alone and combined with dust storms and other meteorological elements, on the incidence of cardiovascular, respiratory, and cerebrovascular diseases.

Goggins and Chan conducted a retrospective cohort study on the short-term association between hospitalization factors, heart failure mortality, hydrometeorological, and climate variables in Hong Kong. This study showed that previous research has demonstrated the winter peaks in low temperatures as the reason for hospitalizations and deaths from congestive heart failure. However, few studies can predict the relationship between meteorological elements and congestive heart failure. The number of daily congestive heart failure admissions in Hong Kong general hospitals accounted for about 83% of all admissions, and the daily heart failure mortality from 2002 to 2011 was obtained. The results of this study showed that both the hospitalization rate of heart failure patients and the resulting mortality in Hong Kong are strongly related to cold air temperature [12].

This study refers to the effects of meteorological elements on hospitalization and mortality due to congestive heart failure. The results of this study show that the hospitalization of heart failure patients and the resulting mortality in Hong Kong are strongly related to cold air temperature. While, this study aims to investigate the effects of different temperature ranges, alone and combined with dust storms and other meteorological elements, on the incidence of cardiovascular, respiratory, and cerebrovascular diseases, which is consistent with some of the objectives of this study.

Vencloviene et al. conducted a retrospective cohort study titled the effect of weather conditions on emergency ambulance calls for Acute Coronary Syndrome (ACS) to evaluate the relationship between weather conditions and emergency ambulance calls for ACS. The study data included 3,631 patients who called the ambulance with chest pain and were admitted to the cardiology department with the ACS. The effect of daily air temperature (T), air pressure barometer (BP), relative humidity, and wind speed (WS) was investigated to identify low and high-risk areas and the daily volume of emergency calls (DV). These results show that daily air temperature, daily-measured air pressure, and wind speed increase the ambulance calls on the same day and two days later can be predictive variables for the risk of an ACS [13].

This study refers to the effect of meteorological elements on hospitalization and pre-hospital ambulance dispatch services for acute coronary disease. The results of this study show that a call to an ambulance on the same day and two days later can be a predictive variable for the risk of ACS. This study examines the effects of dust storms and other meteorological elements on cardiovascular, respiratory, and cerebrovascular disease. It corresponds to some of the objectives of this study.

Zheng et al conducted a study titled a community-based study of the correlation between the occurrence of cerebral hemorrhagic strokes and meteorological factors to discover the relationship between daily meteorological factors and increased incidence of intracerebral hemorrhage (ICH) caused by high blood pressure and Subarachnoid Hemorrhage (SAH). For 2 years, 735 patients with ICH caused by hypertension or SAH from Floreji District, Heilongjiang Province, China, were included in the study. Daily meteorological information was obtained from Kuikohar meteorological office. The study's results showed that the higher prevalence of primary ICH caused by hypertension in late spring and early autumn was due to daily average temperature and changes. When the temperature changes, the incidence of primary ICH due to high Blood Pressure (BP) also increases. On the contrary, the incidence of SAH increased during the day with lower temperatures [14].

This study refers to the effects of meteorological elements on cerebral hemorrhages. The results of this study show that the daily impacts of the average temperature and the changes caused by it can be effective in the prevalence of cerebral hemorrhage. While, this study aims to investigate the effects of dust storms and other meteorological elements on cardiovascular, respiratory, and cerebrovascular diseases and covers several objectives of this study.

Lai conducted a retrospective cohort study titled the relationship between Lushan winds and cardiovascular and respiratory diseases in Hengchun Peninsula, Taiwan. This study examines the relationship between climate change, particles in the air, Lushan winds, and public health in Hengchun Peninsula from January to April and October to December 2006 to 2010. Information on weather conditions, PM with an aerodynamic diameter of less than or equal to 2.5 micrometers (PM_{2.5}), with an aerodynamic diameter of less than or equal to 10 micrometers (PM₁₀), and hospitalization rates for respiratory and cardiovascular diseases were obtained from several government sources in Taiwan. The results indicate that the days when the

Lushan wind blows along with the cold weather and strong local wind have increased the incidence of respiratory diseases, which is also related to the winter season and topographic features [15].

The closest study to this seems to be a study that examines the air temperature and wind speed along with the size of the particle diameter. However, the main difference in this study is the origin of the particles, a mixture of organic particles caused by man-made pollution and mineral pollution caused by wind blowing in deserts. This study investigates the effects of dust storms and meteorological elements on cardiovascular, respiratory, and cerebrovascular diseases.

In a retrospective cohort study, Staskiewicz et al. stated that low atmospheric pressure and low air humidity were more associated with frequent pulmonary embolism episodes in male patients. This study was conducted to investigate the effect of meteorological factors on the incidence of pulmonary embolism in male and female patients. The medical information of patients hospitalized in 2007-2008 was reviewed. The study group included 400 patients with pulmonary embolisms living in an area at an average altitude of about 200 m above sea level, with a maritime continental climate. The results showed that the effect of meteorological factors on the incidence of pulmonary embolism in men was a new result. A prospective study is necessary to further analyze this result [16].

The geographical location and the type of climate mentioned in this study are very similar to Dezful City, Iran, and are consistent with some of the study's objectives.

The overview of the above studies shows that the study of dust storms and meteorological elements on health has been considered for many years; however, a comprehensive study examining the impact of dust storms and meteorological elements on health, alone and combined, is rarely seen. On the other hand, the results of the studies do not definitively confirm the effects of the factors mentioned above on health, or the results are contradictory. Meanwhile, most studies have been conducted in capital cities, metropolises, and densely populated industrial cities, whose air is heavily polluted by man-made organic and mineral pollution. As some studies show, the effects of these pollutants can intensify each other's effects when combined with dust storms and other meteorological elements. And some studies have even attributed the combined impact of dust and air pollution in cities on diseases to man-made pollution, no dust storms.

In this way, these studies are faced serious bias, and the present study intends to reduce these biases.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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