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Investigating the effects of dust storms on morbidity and mortality due to cardiovascular and respiratory diseases: A systematic review

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Abstract:

New epidemiological studies acknowledge the detrimental effects of dust storms on health. The aim of this study was to systematically review the effects of dust storms on the morbidity and mortality rates of cardiovascular and respiratory diseases. The results of this study were obtained based on articles published in English-language journals. For the purpose of this study, all articles published until the end of 2020 based on the search in the "Scopus," "Web of Science," and "PubMed" databases were selected. Articles were searched independently by two trained researchers. Dust storms are the cause of many diseases and health-related complications, of which cardiovascular and respiratory diseases are common. It is necessary to recognize and investigate the harmful effects of dust storms to prevent serious harms to human societies. In the reviewed articles, the impact of dust storms on several diseases, including cardiovascular and respiratory diseases,has been analyzed. Most of these articles acknowledge the effect of dust storms on increasing the incidence and mortality rate of these diseases, although in some articles this effect is not statistically significant. Many studies conducted around the world confirm the harmful effects of dust storms on cardiovascular and respiratory diseases, including increase in the number and duration of hospitalizations, as well as increase in mortality and exacerbation of these diseases. However, some studies do not consider the harmful effects of dust storms on the above diseases to be statistically significant.

Keywords:

Cardiovascular disease, climate change, morbidity, sand storm whit dust

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Introduction

Dust storms affect many parts of the world, encompassing the coasts of North Africa, southern Europe, the Middle East, and East Asia.[1] According to the agreement of the World Meteorological Organization, whenever the wind speed at a station exceeds 15 m per second and the horizontal visibility reaches <1 km, a dust storm is reported. Sandstorms are winds that can move particles 15–30 μ in diameter to a height of 15 m. While dust storms are made up of very fine particles, 1–5 μ in diameter, they move at a much higher altitude and travel very long distances that can cover cities in a country or even countries on a continent.[2] The world's two major dust storms transport millions of tons of minerals to remote areas each year. African dust storms, which often originate

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in the Sahara region, regularly cover the Mediterranean region, Europe, and even the United States at different times of the year. Asian dust storms, which occur mainly in the spring, originate in the deserts of Mongolia and western China, and can affect eastern China, Korea, Japan, Taiwan, and even North America.[3] Although Asian dust is a known natural phenomenon, new epidemiological studies acknowledge its detrimental effects on health. Dust mixes with other pollutants in urban air as it passes through the atmosphere, making its effects more harmful. This dust also contains germs and biological substances that can cause or aggravate respiratory diseases. It also causes cardiovascular disease (CVD) by inflammation in the respiratory system or by the penetration of very fine dust particles into the circulatory system.[4] Dust particles in the atmosphere are generally of particulate matter $(PM)_{2.5}$ to PM_{10}. Numerous studies in recent years have shown their impact on health and mortality. Research has shown that people, who are exposed to dust, even if it is short lived, still increase hospitalization rates and mortality.[5] There have been many studies on the health effects of dust and mortality and morbidity rates that have yielded conflicting results. Studies by Chen *et al*. and Schwartz *et al*. have not found a significant association between the effects of dust and health. In contrast, in the study carried out by Spokin, dust mortality increased during storm days. Findings of many studies indicate the relationship between the presence of dust and respiratory diseases, while less attention has been paid to the role of dust in CVD. In the studies of Chen and Yang ., the effect of dust on CVD has been emphasized.[6] Due to these contradictory results and the increasing number of this phenomenon, we intended to conduct a systematic review of the studies on the effects of dust storms on morbidity and mortality due to CVD and respiratory diseases. The results of this study explore the challenges associated with morbidity and mortality caused by dust storms and examine the existing experiences.

Materials and Methods

The present study is a systematic review on the health effects of dust on mortality and morbidity due to CVD and respiratory diseases. The results of this study were obtained based on articles published in English-language journals without limiting the time of publication of articles. In this study, all articles published until the end of 2020 based on the search in the "Science Direct," "Scopus," "Web of Science," "PubMed," "Google Scholar," "Irandoc," "Magiran," and "SID" databases were selected. Search for articles was carried out using the keywords of "Dust Storm." "Cardiovascular disease," "Cardiovascular mortality," "Cardiovascular morbidity," "Cardiovascular incidence," "Cardiovascular prevalence," "COPD" "Respiratory disease," "Respiratory mortality," "Respiratory incidence," "Respiratory prevalence," "Pulmonary disease," "Pulmonary mortality," "Pulmonary morbidity," "Pulmonary incidence," "Pulmonary prevalence," "Myocardial infarction," "(MI)," "Congestive heart failure," "CHF," and "Asthma" twice in isolation and in combination with AND and OR. Accordingly, first, all articles related to the study of the health effects of dust on mortality and morbidity due to CVD and respiratory diseases were collected and after the search, a list of abstracts was prepared. After concealing the details of the articles such as the author's name and the name of the journal, the full text of the articles was given to two trained and skilled researchers to review the articles. Each article was reviewed by two reviewers independently and in case of rejection of the articles by the two reviewers, the reason was mentioned and in case of disagreement between them, the article was judged by a third person. In order to evaluate the quality of the articles, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist, which has 22 parts, was used. Scoring based on the importance of each part is in accordance with the present study. The final score of the checklist was 33 and the minimum score was 20. All available English-language articles on the health effects of dust on morbidity and mortality from CVD and respiratory diseases, which were of good quality based on the STROBE checklist, were included in this study. Studies that did not consider the health effects of dust on CVD and respiratory diseases were excluded from the study. Such as studies about other risk factors effect of CVD .[7]

A total of 258 articles related to the health effects of dust on morbidity and mortality due to CVD and respiratory diseases were found, of which 39 articles were excluded from the study due to duplication and 112 articles were excluded due to irrelevance to our study. Of these, 107 articles dealt with the various effects of dust on health except cardiovascular and respiratory effects. Among them, 56 articles focused on the health effects of dust on the incidence and mortality of CVD and respiratory diseases. After reviewing the abstracts, 23 articles that lacked the required information were also excluded from further assessment. Finally, 33 articles met the inclusion criteria and were included in the study [Figure 1].

Findings

The extracted articles are categorized in Table 1 based on the year of publication, the study population, the intended outcome, and the tools and the design of the study.

Discussion

Daily, monthly, seasonal, or annual dust concentrations at stations in four West African countries are reported

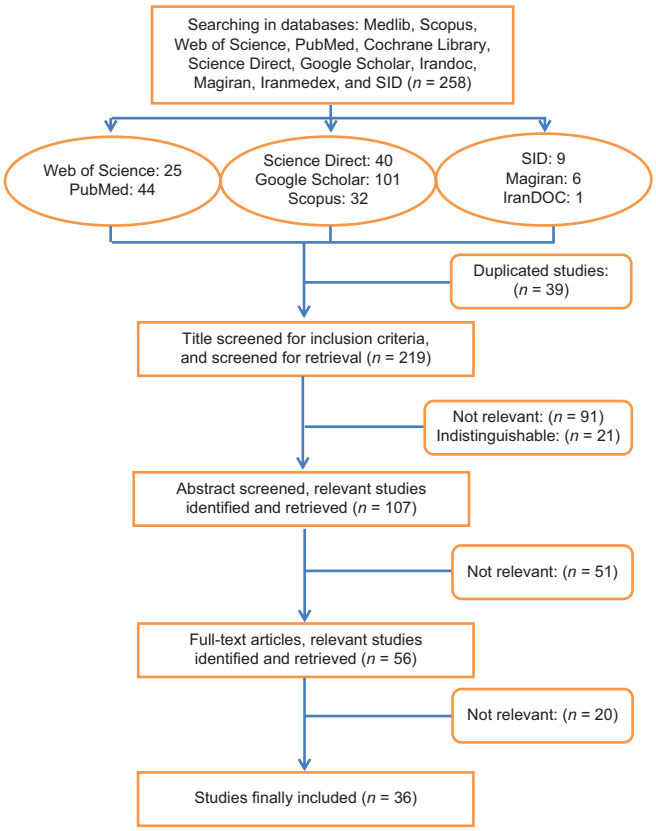

Figure 1: Results of PRISMA flow of the systematic literature search

to be well above the air quality standards set by the European Union, the United States, and the WHO. These results are the first quantitative assessment of the significance of PM_{10} concentrations in West Africa, and these findings suggest that desert dust has adverse health effects on the Sudanese population. All the current evidence suggests that the effects will intensify in the coming years, with the greatest impact on the most vulnerable African populations.[8]

A systematic review study probes the relationship between the occurrence of dust and the health effects of dust in the world and highlights West Africa as an area of interest for study. These studies show that the decline in air quality has significant negative effects on human health. Although some results appear to have a lesser impact, there is no significant discrepancy. While few studies on desert dust have been published, the available evidence indicates that desert dust has a significant impact on human health. Many studies are not close to the sources of the dust; however, the effects of this desert dust on the increase in disease incidence and disease mortality have clearly reached alarming levels. Although dust events are more common and severe in West Africa than anywhere else, their health effects have not been fully evaluated.[9]

A study conducted in Taipei shows that in a day with moderate pollution, daily mortality is associated with the amount of pollution. The mortality rate was 68 on a day, when the mean PM_{10} particle level was 125.94/m^3. This rate was very close to 68 for other pollutants (CO, NO, and SO_2). However, this amount was more significant for O_3 compared to other days. Temperature and humidity during the dust storm were lower than normal. Overall, the average number of nonaccidental deaths in the city was 27. The effects of dust storms on the total mortality due to CVD 2 days after the occurrence of these storms were prominent and significant. For respiratory illness mortality, dust was highest 1 day after the event and then declining.[10] An average of 67 CVD patients were admitted on dust storm days. The average number of daily admissions of patients with CVD was higher compared to the same days. The effects of dust storm on CVD were detected after 1 day and then decreased. The effects of dust storm on CVD admission were significantly reduced 3 days after dust events.[6] An average of 58 RDS patients were admitted on dust storm days. The average number of daily admissions of patients with RDS was slightly higher compared to that of the same days. The association between the dust storm and the highest significant acceptance of pneumonia was 1 day after the event. The results were evaluated. After removing 1%, 5%, and 10% of consecutive days with the lowest PM_{10} concentrations, there were small changes in the estimation of pneumonia risk on dusty days.[14] With a maximum delay of 3 days, for all 47 hospitals in Taipei, there were an average of 21 admissions of chronic obstructive pulmonary disease (COPD) patients in the dust storm, with an average age of 71.78 years. The average number of daily admissions of patients with COPD was slightly higher compared to that of the same days. The highest number of hospital admissions for COPD patients was at a maximum of 3 days after the dust accident. However, these values were not statistically significant. The results of the model were examined. After removing 1%, 5%, and 10% of consecutive days with the lowest PM_{10} concentration, there were small changes in the estimation of COPD risk on dusty days.[15]

The 3-day return routes show that air trains arrived in Seoul, mostly through desert areas in China and Mongolia during the Asian Dust Storm (ADS) event. The levels of fine particles in these three cities may reflect the common origin of ADS and appear to be related. The concentration of pollutants seems to have been maintained in Beijing for the past few days, and a few days later with a lower concentration in Seoul. We divided the particles into $PM_{2.5}$ and PM_{10} groups. The proportion of natural metal compounds attached to the particles was much higher than that of anthropogenic pollutants. In particular, the proportion of natural metals was higher in Alashan, which was close to the source of ADS, while the proportion of human-made metal pollutants was higher in Beijing. In this research, 56 male

Table 1: General specifications of articles eligible for systematic review

Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
1	Crooks *et al.*[1]	The Association between Dust Storms and Daily NonAccidental Mortality in the United States, 1993-2005	2016	North of the USA	Dust storms are associated with increases in lagged nonaccidental and cardiovascular mortality	Logistic regression models under a time-stratified case-crossover design were used to study the relationship between dust storms and daily mortality counts over the whole United States and in Arizona and California specifically	Retrospective cohort	Dust storms are associated with increases in lagged nonaccidental and cardiovascular morbidity and mortality
2	De Longueville *et al.*[8]	Saharan Dust Impacts on Air Quality: What Are the Potential Health Risks in West Africa?	2013	West Africa	Importance of carrying out impact studies of Saharan dust in West Africa, where dust events are more frequent and intense than anywhere else	Logistic regression models under a time-stratified case-crossover design were used to study the relationship between dust storms and daily mortality counts over the whole United States and in Arizona and California specifically Tapered Element Oscillating Microbalance (TEOM 1400A from Thermo Scientific) Checklist Horizontal view assessment based on meteorological data	Quantitative cross sectional	The results should encourage the extent of air quality monitoring in this African sub-region and the collection of health data to assess the real impacts of Saharan dust on health All evidence now suggests that the effects will be amplified in coming years and that the African populations that will remain the most exposed are the most vulnerable
3	de Longueville *et al.*[9]	Desert Dust Impacts on Human Health: An Alarming Worldwide Reality and a Need for Studies in West Africa	2013	West Africa	Importance of carrying out impact studies of Saharan dust in West Africa, where dust events are more frequent and intense than anywhere else	Articles and documents	Review	These studies show that air quality deterioration caused by desert dust is associated with significant impacts on human health (morbidity/mortality respiratory diseases/CVDs)
4	Chen *et al.*[10]	Effects of ADS Events on Daily Mortality in Taipei, Taiwan	2004	Taipei	Relationship between dust storm and mortality	Pollution and health data	Retrospective cohort	The best air quality indicators for evaluating the short-term health effects (morbidity/mortality respiratory diseases/CVDs) of PM
5	Jiménez *et al.*[5]	Role of Saharan Dust in the Relationship between Particulate Matter and Short-Term Daily Mortality Among the Elderly in Madrid (Spain)	2010	Madrid	Relationship between dust storm and mortality	Pollution and health data	Poisson regression model	Madrid are therefore PM10 concentrations on days with, and PM2.5 concentrations on days without Saharan This fact should be taken into account in a European Directive regulating ambient air quality in almost all countries in the Mediterranean area

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
6	Alessandrini *et al.*[11]	Saharan Dust and the Association between Particulate Matter And Daily Hospitalisations in Rome, Italy	2015	Rome	Relationship between dust storm and mortality	Pollution and health data	Poisson regression model	A clear enhanced effect of PM2.5-10 on respiratory diseases and of PM10 on cerebrovascular diseases emerged during Saharan dust outbreaks This suggests a specific contribution of Saharan dust composition to the toxicity of PM2.5-10 and PM10
7	Barnett *et al.*[12]	The Effects of the 2009 Dust Storm on Emergency Admissions to a Hospital in Brisbane, Australia	2012	Brisbane	No increase in respiratory admissions	Pollution and health data	Poisson regression model	The dust storm had a short-lived impact on respiratory and cardiovascular emergency hospital admissions EDs should be prepared for a short-term increase in admissions during dust storms
8	Bennett *et al.*[13]	Impact of the 1998 Gobi Dust Event on Hospital Admissions in The Lower Fraser Valley, British Columbia	2006	British Columbia	Gobi dust event was not associated with an excess of hospitalizations	Pollution and health data	Time-series analyses	Despite high PM concentrations, fine particle size, presence of heavy metals in the dust, and extended exposure periods, it appears that the Gobi desert dust event was not associated with significant risk to public health (respiratory and cardiac illnesses hospital admissions) in Greater Vancouver, British Columbia
9	Chan *et al.*[3]	Increasing Cardiopulmonary Emergency Visits by Long-Range Transported ADSs in Taiwan	2008	Taipei	Relationship between dust storm and mortality	Pollution and health data	Two-tail paired t-test Poisson regression model	ADSs increase cardiopulmonary emergency visits, ischemic heart diseases, cerebrovascular diseases, and COPD during storm-affecting periods in Taipei when ambient PM10 concentrations are above 90 mg/m3
10	Kojima *et al.*[4]	Asian Dust Exposure Triggers AMI	2017	Kumamoto	Asian dust events may lead to AMI and have a great impact on its onset in patients with CKD	Pollution and health data	Tests of student	Asian dust events may lead to AMI and have a great impact on its onset in patients with CKD Despite the limitations of the present study, the results provide strong evidence to emphasize health education and communication with patients at risk for AMI
11	Chen and Yang[6]	Effects of ADS Events on Daily Hospital Admissions for CVD in Taipei, Taiwan	2005	Taipei	Effect of dust storms on CVD admissions was not statistically significant	Pollution and health data	Tests of student	ADS events may increase the risk of daily hospital admissions for CVD in Taipei, although the association was not statistically significant Nonetheless, it is worthwhile to focus more attention on the potential adverse effects of ADS events in future

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
12	Cheng *et al.*[14]	Consequences of Exposure to ADS Events on Daily Pneumonia Hospital Admissions in Taipei, Taiwan[14]	2008	Taipei	Effect of dust storms on pneumonia admissions was statistically significant	Pollution and health data	Poisson regression models	The analysis indicated a statistically significant association between ADS events and daily pneumonia admissions. It is worthwhile to pay more attention to the ADS events and health in future
13	Chiu *et al.*[15]	Effects of ADS Events on Hospital Admissions for COPD in Taipei, Taiwan	2008	Taipei	Effect of dust storms on COPD admissions was not statistically significant	Pollution and health data	Poisson regression	ADS events may increase the risk of daily hospital admissions for COPD in Taipei, although the association seen in this study was not statistically significant. There may not have been enough power to detect an association resulting from the inadequate sample size of COPD admissions on ADS events days
14	Hong *et al.*[16]	ADS and Pulmonary Function of School Children in Seoul	2010	Seoul	Effect of dust storms on reducing children's pulmonary function, was statistically significant	Experimental design	Linear mixed-effects model	Outdoor particulate concentrations during the ADS period were not significantly associated with PEFR change in school children except asthmatics
15	Johnston *et al.*[17]	Extreme Air Pollution Events from Bushfires And Dust Storms and Their Association With Mortality in Sydney, Australia 1994-2007	2011	Sydney	The magnitude and temporal patterns of association with mortality were different for smoke and dust events	Pollution and health data	Time-stratified case crossover design with conditional logistic regression	The magnitude and temporal patterns of association with mortality (cardiovascular and respiratory) were different for smoke and dust events Public health advisories during bushfire smoke pollution episodes should include advice about hot weather in addition to air pollution
16	Kanatani *et al.*[18]	Desert Dust Exposure is Associated with Increased Risk of Asthma Hospitalization in Children	2010	Toyama	Heavy dust events are associated with an increased risk of hospitalizations for asthma	Pollution and health data	Conditional logistic regression	This study suggested that heavy dust events were significantly associated with the increased risk of asthma admission for children with asthma
17	Lai and Cheng[19]	The Impact of Air Quality on Respiratory Admissions During ADS Periods	2008	Taipei	Effect of dust storms on respiratory admissions was statistically significant	Pollution and health data	Spatial analysis in GIS	It has been found that there is a direct relationship between the length of an ADS period and the number of admissions, with a longer ADS period resulting in a larger variation of the respiratory admission count
18	Meng and Lu[20]	Dust Events As a Risk Factor for Daily Hospitalization for Respiratory and CVDs in Minqin, China	2007	Minqin	The health effects of dust events are consistent with recent animal and human data showing the respiratory and cardiovascular effects of PM	Pollution and health data	Generalized additive Poisson regressions	The results imply that generalized efforts to preserve cardiopulmonary health should help prevent (or at least postpone) illnesses associated with dust events

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
19	Monteil[21]	Saharan Dust Clouds and Human Health in the English-Speaking Caribbean: What We Know And Don't Know	2008	Caribbean island	It is suggested that there is a need for a prospective Caribbean-wide study to assess fully any relationship between African dust clouds and human respiratory and CVDs	Pollution and health data	Review	The results have been conflicting. This review examines these studies, offers possible explanations for the differences in results, and suggests that there is a need for a prospective Caribbean-wide study to assess fully any relationship between African dust clouds and human respiratory and CVDs
20	Park *et al.*[22]	Effects of Ambient Particulate Matter on PEFRs and Respiratory Symptoms of Asthmatics During Asian Dust Periods in Korea	2005	Incheon	Effect of dust storms on the respiratory symptoms of individuals with bronchial asthma, was statistically significant	Pollution and health data	The general additive model approach with Poisson log-linear regression	This study provides evidence that Asian dust events impacting the respiratory symptoms of individuals with bronchial asthma, and ambient air pollution, particularly elevated PM10, might be one of the aggravating factors in this respect
21	Perez *et al.*[23]	Coarse Particles From Saharan Dust and Daily Mortality	2008	Barcelona	Further investigation is needed to understand the role of coarse particles and the mechanism by which Saharan dust increases mortality	Pollution and health data	Conditional logistic regression	Saharan dust outbreaks may have adverse health effects. Further investigation is needed to understand the role of coarse particles and the mechanism by which Saharan dust increases mortality
22	Prospero *et al.*[24]	Relationship between African Dust Carried in the Atlantic Trade Winds and Surges in Pediatric Asthma Attendances in the Caribbean	2008	Barbados	Effect of dust storms on asthma admissions was not statistically significant	Pollution and health data	Mann-Whitney rank-sum test, two tailed	The transport of dust across the tropical North Atlantic has increased greatly beginning in the early 1970s with the onset of the drought that continues in varying degrees to this day. The drought has been linked in part to global warming. Thus, to the extent that African dust has an impact on health, the impact could be attributed in part to anthropogenic causes
23	Rutherford *et al.*[25]	Characteristics of Rural Dust events Shown to Impact on Asthma Severity in Brisbane, Australia	1999	Brisbane	The results indicate that a number of dust events were significantly associated with changes in asthma severity, but general relationships could not be determined	Pollution and health data	Paired two-tailed *t*-tests	The results indicate that a number of dust events were significantly associated with changes in asthma severity, but general relationships could not be determined Given that the phenomenon of wind-blown dust is not isolated to the Australian continent, these findings raise important questions about the effects of wind-blown dust in other parts of the world

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
24	Schwartz *et al.*[26]	Episodes of High Coarse Particle Concentrations Are Not Associated with Increased Mortality	1999	Six US cities	Effect of dust storms on mortality was not statistically significant	Pollution and health data	Poisson regression	The results suggested that dust storms are not a significant threat to respiratory and cardiovascular health and that regulatory efforts should not be focused on dust storms
25	Ueda *et al.*[27]	The Effects of Weather, Air Pollutants, and Asian Dust on Hospitalization for Asthma in Fukuoka	2010	Fukuoka	Effect of dust storms on asthma admissions was not statistically significant	Pollution and health data	Time-stratified case cross-over design and logistic regression	This study showed that temperature fluctuation, SPM, and NO2 were associated with an increased risk of hospitalization of children for asthma
26	Wang *et al.*[28]	The Threat of ADSs on Asthma Patients: A Population-Based Study in Taiwan	2014	Taipei	Effect of dust storms on pediatric asthma admissions was statistically significant	Pollution and health data	The daily average deaths between Asian dust and control days	The degree of severity of each ADS event is not taken into account. Air quality and toxic level may vary in different ADS events, which might affect the risk of asthma hospitalization. It is noteworthy that the extra cost between post-ADS day and other days is a crude estimate
27	Watanabe *et al.*[29]	Correlation between ADSs and Worsening Asthma in Western Japan	2011	Western Japan	Effect of dust storms on adult asthma admissions was mild statistically significant	Pollution and health data	Mann-Whitney nonparametric test, Chi-square test, and multivariate logistic regression analysis	It was found that ADS aggravated lower respiratory symptoms in adult patients with asthma, but this influence was mild
28	Wiggs *et al.*[30]	The Dynamics and Characteristics of Aeolian Dust in Dryland Central Asia: Possible Impacts on Human Exposure and Respiratory Health in the Aral Sea Basin	2003	Autonomous Republic of Karakalpakstan	Effect of dust storms on respiratory problems was inverse and the relationship was statistically significant	Pollution and health data	Spatio-temporal analysis	Provisional analysis of the respiratory health data suggests that children living in the north of the country, where Aeolian dust deposition rates are greater, show a lower frequency of respiratory problems. This inverse relationship requires further investigation, but highlights the complexities of environmental and human health inter-relationships
29	Yang *et al.*[31]	Effects of ADS Events on Hospital Admissions for CHF in Taipei, Taiwan	2009	Taipei	Effect of dust storms on CHF admissions was statistically significant	Pollution and health data	Spatio-temporal analysis	In summary, ADS events may increase the risk of hospital admissions for CHF in Taipei, although the association seen in this study was not statistically significant. There may not have been enough power to detect an association resulting from the inadequate sample size of CHF admissions on ADS events days

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
30	Yoo *et al.*[32]	Acute Effects of Asian Dust Events on Respiratory Symptoms and Peak Expiratory Flow in Children with Mild Asthma	2008	Seoul	Effect of dust storms on increased acute respiratory symptoms was statistically significant	Pollution and health data	Kruskal-Wallis test/Pearson correlation test/ paired *t*-test	These findings indicate that Asian dust events increase the risk of acute respiratory symptoms and pulmonary function deterioration, but do not appear to have long-term influence on AHR in children with mild asthma
31	Yu *et al.*[33]	ADS Elevates Children's Respiratory Health Risks: A Spatiotemporal Analysis of Children's Clinic Visits across Taipei (Taiwan)	2012	Taipei	Effect of dust storms on increased acute respiratory diseases was statistically significant	Pollution and health data	Poisson regression models	The study results clearly show significant and increased rates for respiratory clinic visits in the studied population of children over time in 5 of 7 days after ADS
32	Gyan *et al.*[34]	African Dust Clouds are Associated with Increased Paediatric Asthma Accident and Emergency Admissions on The Caribbean Island of Trinidad	2005	Caribbean island	Effect of dust storms on pediatric asthma admissions was statistically significant	Pollution and health data	Poisson regression models	The best fitting model estimated that in one month, such as June, a deterioration of visibility due to increased Saharan dust cover from no dust (visibility=16 km) to very dusty (visibility=7 km) would increase a daily admission rate of 7.8 patients to 9.25, when climate variables such as barometric pressure and humidity were kept constant
33	Goudie[35]	Desert Dust and Human Health Disorders	2014	Global	Human health effects of dust storms are respiratory disorders (including asthma, tracheitis, pneumonia, allergic rhinitis, and silicosis) cardiovascular disorders (including stroke), conjunctivitis, skin irritations, meningococcal meningitis, valley fever, diseases associated with toxic algal blooms and mortality and injuries related to transport accidents	Pollution and health data	Review	An increasing corpus of studies, particularly in east Asia, show associations between dust events and a range of human health issues, including respiratory problems, cardiovascular complaints, and other problems. There are, however, some parts of the world, including the Gulf States of the Middle East, and countries in northern and western Africa, where relatively little epidemiological research has been published on the relationship between dust events and health
34	Lorentzou *et al.*[36]	Extreme Desert Dust Storms and COPD Morbidity on the Island of Crete	2019	Island of Crete	Effect of dust storms on increased COPD was statistically significant	Pollution and health data	Poisson regression models	Extreme desert dust storm episodes may cause meaningful increases in ED visits for dyspnea and COPD exacerbations/admissions

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Number	Author	Title	Year	Society surveyed	Outcome	Study tool	Study design	Conclusion and suggestions
35	Ishii *et al*.[37]	ShortTerm Exposure to Desert Dust and the Risk of AMI in Japan: A TimeStratified CaseCrossover Study	2020	Japan	Effect of dust storms on increased MINOCA was statistically significant	Pollution and health data	A time-stratified case-crossover design and conditional logistic regression models	This study provides evidence that short-term exposure to AD is associated with a higher risk of MINOCA, rather than MI-CAD

MI=Myocardial infarction, COPD=Chronic obstructive pulmonary disease, CKD=Chronic kidney disease, AMI=Acute MI, CVDs=Cardiovascular diseases, ADS=Asian dust storms, PEFRs=Peak expiratory flow rates, CHF=Congestive heart failure, EDs=Emergency departments, CAD=Coronary artery disease, AD=Asian Dust, GIS=Geographic Information System, SPM=Suspended Particulate Meter, AHR=Airway Hypersensitive, MINOCA=Myocardial Infraction whit Non Obstructive Coronary Arteries, PM=Particulate matter

and 54 female students at an elementary school in Seoul were studied. The mean age of the participants was 3.9 years and some of them had a history of asthma and exposure to second-hand smoke by the age of 18 (16.8%) and 20 years (18.7%). This result indicates that exposure of bonded metals to dust particles during the ADS period reduces children's lung function, but there is no power difference in statistical tests to reduce lung function between natural and human-made metal parts.[16]

In a study conducted in Madrid, out of a total of 1096 days examined during the study period, the infiltration of desert dust in Madrid was 219, which accounts for 20% of the days analyzed. The percentage of days with the presence of African dust in 2003 was 4.27%, 9.18% in 2004, and 7.13% in 2005. The total mortality due to the underlying causes in the study population is as follows: 8617 days for desert dust events (1550 due to respiratory diseases and 3071 due to CVD) and 35,397 days without dust event (6838 due to respiratory diseases and 12,716 due to CVD). Among people over 75 years of age, the average daily mortality due to each of the three causes studied was similar for days with and without the infiltration of desert dust.[5]

In Rome, during the warm seasons of the year, about 19% of the days of the year between 2001 and 2004 are affected by desert dust. The average particle concentration during the day was higher than that of dust-free days and the concentration of coarse particles was higher than that of fine particles. The air temperature and apparent temperature were higher during the days with the dust event than on the days without dust. The findings of this study show the relationship between mortality and coarse particles. The components of this dust include bacteria, fungi, viruses, and 11 types of human contaminants that cause various levels of strong inflammatory effects on the cell surface. A recent study on cardiovascular mortality in Madrid, Spain, indirectly shows the effects of dust particles on morbidity and mortality from these diseases. The authors obtained different effects from both organic and inorganic compounds in the dust and showed the destructive effect of human pollutants and their synergy on days with the dust event. We do not have complete information about the PM components in Rome. In addition, the small number of dusty days prevents accurate analysis of personal factors such as age and gender. In conclusion, our study showed a positive effect of $PM_{2.5–10}$ on the increase in respiratory disease and PM_{10} on the incidence of cerebrovascular disease during the days affected by the desert dust event. This finding indicates that a certain proportion of the compounds in desert dust are $PM_{2.5–10}$ and PM_{10}. It is recommended to pay more attention to the particle type and size in deserts in order to conduct similar studies in future.[11]

In Japan, 21 participating institutions across Kumamoto that are capable of performing coronary interventions were included in the study. Data from Asian dust events were measured at the Kumamoto Meteorological Center. Data were analyzed from 3713 patients with acute MI (AMI) from April 1, 2010, to March 31, 2015. The incidence of AMI, 1 day after the occurrence of Asian dust events, had significantly correlated, and this significance was clearly higher for patients with non-ST-elevation MI. There was a significant relationship between AMI and Asian dust in male patients with chronic kidney disease, diabetes, and nonsmokers aged 75 years. However, Asian dust events had a significant impact on the onset of AMI in patients with CKD ($P < 0.01$). Analysis of research data showed that Asian dust events may lead to AMI and have a significant effect on its onset in patients with CKD.[4]

CVD is affected by variouse resurese, such as sress[38] and other risk factor such as in this time for pandemic COVID-19.[39] this interfernings might by effect in mortality or morbidity of patient.

Research Limitations

In various articles, the incidence and mortality of CVD and respiratory diseases have been mentioned in general, but the incidence and mortality of CVD and respiratory diseases were not mentioned in detail. Although in this study only English-language articles were reviewed, it is possible that non-English-language articles that are in line with the objectives of the present study were not reviewed.

Conclusion

According to previous studies, the trend of creating dust storms around the world is increasing. In the field of health, the effects of these storms on various diseases, especially the increase in the hospitalization process on days with the occurrence of dust events, have been emphasized in many articles. The cause of these hospitalizations is mostly respiratory and heart diseases and, of course, the mortality rate in relation to these diseases is clear in studies. However, some studies do not mention the statistically significant cases, and the certainty of the results is questionable. The type and size of particles in the dust have been studied in some studies and the effect of these parameters in causing disease or prolongation of diseases has been highlighted, which often indicate contradictory results in this field. The synergistic effects of human-made pollutants and particles in dust storms have also been considered in some studies. Considering all the aspects and studies done, it seems that there is still a need for further studies in this field to clarify the many hidden angles that are still uncovered.

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Conflicts of interest

There are no conflicts of interest.

References

1. Crooks JL, Cascio WE, Percy MS, Reyes J, Neas LM, Hilborn ED. The association between dust storms and daily non-accidental mortality in the United States, 1993–2005. Environ Health Perspect 2016;124:1735.
2. Ansari Ranani M. Statistical-Climate Analysis of Zahedan Dust from 2005 to 1968. The First International Congress on Dust and Countering Its Impacts Ahwaz; 1390.
3. Chan CC, Chuang KJ, Chen WJ, Chang WT, Lee CT, Peng CM. Increasing cardiopulmonary emergency visits by long-range transported Asian dust storms in Taiwan. Environ Res 2008;106:393-400.
4. Kojima S, Michikawa T, Ueda K, Sakamoto T, Matsui K, Kojima T, *et al*. Asian dust exposure triggers acute myocardial infarction. Eur Heart J 2017;38:3202-8.
5. Jiménez E, Linares C, Martínez D, Díaz J. Role of Saharan dust in the relationship between particulate matter and short-term daily mortality among the elderly in Madrid (Spain). Sci Total Environ 2010;408:5729-36.
6. Chen YS, Yang CY. Effects of Asian dust storm events on daily hospital admissions for cardiovascular disease in Taipei, Taiwan. J Toxicol Environ Health A 2005;68:1457-64.
7. Shahbazi A, Rahmani N, Abbasi M, Amjad RN, Marioryad H, Khammar AR, *et al*. Association between occupational stress and risk factors of cardiovascular disease in locomotive operators. Iran Heart J 2018;19:20-6.
8. De Longueville F, Hountondji YC, Ozer P, Marticorena B, Chatenet B, Henry S. Saharan dust impacts on air quality: What are the potential health risks in West Africa? Hum Ecol Risk Assess 2013;19:1595-617.
9. de Longueville F, Ozer P, Doumbia S, Henry S. Desert dust impacts on human health: An alarming worldwide reality and a need for studies in West Africa. Int J Biometeorol 2013;57:1-9.
10. Chen YS, Sheen PC, Chen ER, Liu YK, Wu TN, Yang CY. Effects of Asian dust storm events on daily mortality in Taipei, Taiwan. Environ Res 2004;95:151-5.
11. Alessandrini ER, Stafoggia M, Faustini A, Gobbi GP, Forastiere F. Saharan dust and the association between particulate matter and daily hospitalisations in Rome, Italy. Occup Environ Med 2013;70:432-4.
12. Barnett AG, Fraser JF, Munck L. The effects of the 2009 dust storm on emergency admissions to a hospital in Brisbane, Australia. Int J Biometeorol 2012;56:719-26.
13. Bennett CM, McKendry IG, Kelly S, Denike K, Koch T. Impact of the 1998 Gobi dust event on hospital admissions in the Lower Fraser Valley, British Columbia. Sci Total Environ 2006;366:918-25.

14. Cheng MF, Ho SC, Chiu HF, Wu TN, Chen PS, Yang CY. Consequences of exposure to Asian dust storm events on daily pneumonia hospital admissions in Taipei, Taiwan. J Toxicol Environ Health A 2008;71:1295-9.
15. Chiu HF, Tiao MM, Ho SC, Kuo HW, Wu TN, Yang CY. Effects of Asian dust storm events on hospital admissions for chronic obstructive pulmonary disease in Taipei, Taiwan. Inhal Toxicol 2008;20:777-81.
16. Hong YC, Pan XC, Kim SY, Park K, Park EJ, Jin X, *et al*. Asian Dust Storm and pulmonary function of school children in Seoul. Sci Total Environ 2010;408:754-9.
17. Johnston F, Hanigan I, Henderson S, Morgan G, Bowman D. Extreme air pollution events from bushfires and dust storms and their association with mortality in Sydney, Australia 1994-2007. Environ Res 2011;111:811-6.
18. Kanatani KT, Ito I, Al-Delaimy WK, Adachi Y, Mathews WC, Ramsdell JW, *et al*. Desert dust exposure is associated with increased risk of asthma hospitalization in children. Am J Respir Crit Care Med 2010;182:1475-81.
19. Lai LW, Cheng WL. The impact of air quality on respiratory admissions during Asian dust storm periods. Int J Environ Health Res 2008;18:429-50.
20. Meng Z, Lu B. Dust events as a risk factor for daily hospitalization for respiratory and cardiovascular diseases in Minqin, China. Atmos Environ 2007;41:7048-58.
21. Monteil MA. Saharan dust clouds and human health in the English-speaking Caribbean: What we know and don't know. Environ Geochem Health 2008;30:339-43.
22. Park JW, Lim YH, Kyung SY, An CH, Lee SP, Jeong SH, *et al*. Effects of ambient particulate matter on peak expiratory flow rates and respiratory symptoms of asthmatics during Asian dust periods in Korea. Respirology 2005;10:470-6.
23. Perez L, Tobias A, Querol X, Künzli N, Pey J, Alastuey A, *et al*. Coarse particles from Saharan dust and daily mortality. Epidemiology 2008;19:800-7.
24. Prospero JM, Blades E, Naidu R, Mathison G, Thani H, Lavoie MC. Relationship between African dust carried in the Atlantic trade winds and surges in pediatric asthma attendances in the Caribbean. Int J Biometeorol 2008;52:823-32.
25. Rutherford S, Clark E, McTainsh G, Simpson R, Mitchell C. Characteristics of rural dust events shown to impact on asthma severity in Brisbane, Australia. Int J Biometeorol 1999;42:217-25.
26. Schwartz J, Norris G, Larson T, Sheppard L, Claiborne C, Koenig J. Episodes of high coarse particle concentrations are not associated with increased mortality. Environ Health Perspect 1999;107:339.
27. Ueda K, Nitta H, Odajima H. The effects of weather, air pollutants, and Asian dust on hospitalization for asthma in Fukuoka. Environ Health Prev Med 2010;15:350-7.
28. Wang CH, Chen CS, Lin CL. The threat of Asian dust storms on asthma patients: A population-based study in Taiwan. Glob Public Health 2014;9:1040-52.
29. Watanabe M, Yamasaki A, Burioka N, Kurai J, Yoneda K, Yoshida A, *et al*. Correlation between Asian dust storms and worsening asthma in Western Japan. Allergol Int 2011;60:267-75.
30. Wiggs GF, O'hara SL, Wegerdt J, Van Der Meer J, Small I, Hubbard R. The dynamics and characteristics of aeolian dust in dryland Central Asia: Possible impacts on human exposure and respiratory health in the Aral Sea basin. Geograp J 2003;169:142-57.
31. Yang CY, Cheng MH, Chen CC. Effects of Asian dust storm events on hospital admissions for congestive heart failure in Taipei, Taiwan. J Toxicol Environ Health A 2009;72:324-8.
32. Yoo Y, Choung JT, Yu J, Kim DK, Koh YY. Acute effects of Asian dust events on respiratory symptoms and peak expiratory flow in children with mild asthma. J Korean Med Sci 2008;23:66-71.
33. Yu HL, Chien LC, Yang CH. Asian dust storm elevates children's respiratory health risks: A spatiotemporal analysis of children's clinic visits across Taipei (Taiwan). PLoS One 2012;7:e41317.
34. Gyan K, Henry W, Lacaille S, Laloo A, Lamsee-Ebanks C, McKay S, *et al*. African dust clouds are associated with increased paediatric asthma accident and emergency admissions on the Caribbean island of Trinidad. Int J Biometeorol 2005;49:371-6.
35. Goudie AS. Desert dust and human health disorders. Environ Int 2014;63:101-13.
36. Lorentzou C, Kouvarakis G, Kozyrakis GV, Kampanis NA, Trahanatzi I, Fraidakis O, *et al*. Extreme desert dust storms and COPD morbidity on the island of Crete. Int J Chron Obstruct Pulmon Dis 2019;14:1763-8.
37. Ishii M, Seki T, Kaikita K, Sakamoto K, Nakai M, Sumita Y, *et al*. Short-term exposure to desert dust and the risk of acute myocardial infarction in Japan: A time-stratified case-crossover study. Eur J Epidemiol 2020;35:455-64.
38. Saberinia A, Abdolshahi A, Khaleghi S, Moradi Y, Jafarizadeh H, Sadeghi Moghaddam A, *et al*. Investigation of relationship between occupational stress and cardiovascular risk factors among nurses. Iran J Public Health ,2020;49:1954-8.
39. Poursadeqiyan M, Bazrafshan E, Arefi MF. Review of environmental challenges and pandemic crisis of Covid-19. J Educ Health Promot 2020;9:250.