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RESEARCH PAPER

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Influences of climate change on admissions to the emergency department in Al Baha City, KSA: A frequency analysis study

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Abstract

Being a primary healthcare facility that receives most patient cases, especially critical ones, the Emergency Department is one of the most important departments in the hospital. The aim of this study was to evaluate the influences of climate change on the frequencies of admissions to the Emergency Department in Al Baha City, KSA. A retrospective frequency analysis study was conducted in the intended hospitals. A total of 82,254 patients were admitted to the Emergency Department during the period from January to December 2023. A comparison of disease cases admitted to the emergency department and patient characteristics (age, sex, gender, etc.) across months was included in the analysis. As a result, gastrointestinal conditions, respiratory system conditions, cardiovascular diseases, car accidents, diabetes, and snake bites constituted the largest percentage of cases, some of which were influenced by weather fluctuations. The findings suggest there may be an association between certain emergency disease frequencies and climate change, as well as the high altitude of the area situated between mountain chains. Therefore, it is necessary to emphasize the importance of health education, particularly vaccination, adopting healthy habits suited to changing weather conditions, and adhering to traffic instructions during foggy weather and the fall season to reduce traffic accidents.

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Introduction

An emergency department, sometimes referred to as a casualty department or accident and emergency room, is a kind of medical facility that specializes in providing walk-in patients without an appointment with prompt care. Hospitals and other primary care settings typically have emergency rooms, and many of them provide 24-hour emergency services. Patients can go there on their own or by ambulance (Kellermann et al., 2006). Therefore, a health care delivery system must have 24/7 access to emergency medical care (Sakr et al., 2000). According to (Miller et al., 2010) an emergency department is also referred to as a casualty department or accident and emergency room. The collection of physical, chemical, and biological components (soil, climate, and living creatures) that affect an organism or environmental community and ultimately determine its survival and form is referred to as the environment in medical definitions. It can also sometimes lead to exposure to bacteria that have not been detected before or that are associated with seasonal fluctuations, which can spread infection. On rare occasions, it even leads to the persistence of these microbes, demonstrating how important effective observation and management are (Morelli, 2011; Johnson et al., 1997). There are many different types of such as those caused by chemical, biological, physical, and other environmental factors, (Prüss et al., 2016). Many illnesses, like colds, coughs, and influenza in the winter, malaria and dengue fever in the monsoon, and diarrhea in the summer are linked to the varying seasons of the year. These illnesses can result in a variety of issues from minor ones like feeling under the weather to more serious ones like needing to visit the hospital for treatment and, in the worst cases, dying (D'Amato et al., 2006). Certain environmental conditions can potentially increase the geographic spread of an existing disease or raise the incidence of infection (Corvalán et al., 2016). This is comparable to chest infections, which can be brought on by air pollution and other variables linked to climate change in the lungs and other respiratory system parts (Nash et al., 2006). This may have many effects on those who have asthma and allergic autoimmune illnesses, such as increased

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exposure to asthma triggers (Kelly et al., 2023). Furthermore, exposure to low temperatures is linked to a higher risk of acute myocardial infarction and a worsening of glycaemic control, while there is conflicting data on the death rate from the cold in diabetes patients (Vallianou et al., 2021). Climate change, due to its increasing impacts on the environment, is accelerating the emergence of many non-communicable diseases, including cardiovascular diseases. The persistent associations and mutual causal connections between air pollution and climate change, despite their apparent independence, may ultimately lead to worsening cardiovascular health (Jacobsen et al., 2021; Maria et al., 2017). High blood pressure throughout the night in the summer can also be attributed to factors other than temperature, such as physical discomfort and poor quality of sleep brought on by the summertime. Compared to other seasons, wintertime rise of daytime blood pressure is probably linked to a higher incidence of cardiovascular disease, (Maria et al., 2017). Car accidents are among the situations that call for immediate attention. These incidents are frequently impacted by elements like dirt, fog, and heavy rain, as is the case in several hilly areas of the Kingdom of Saudi Arabia (Parati, 2005; Zayid, 2021). Furthermore, a lot of insects and reptiles might have their behavior altered by high temperatures, giving them an odd appearance. The relationship between snakes and some venomous insects, like scorpions, humans, and the environment can occasionally change due to climate change. This can change the prevalence of snake bites, which are regarded as a medical emergency, a health hazard, and a threat everywhere, where it is the cause of mortality among agricultural laborers and farmers, particularly in impoverished and rural areas, (Koetse et al., 2009; Williams et al., 2010). Due to a variety of bacterial, parasite, and viral causes, environmental factors-particularly climate-have an impact on the incidence of gastroenteritis. The spring and summer seasons are when gastrointestinal outbreaks that result in hospitalization due to diarrheal illnesses increase, according to recent studies. Environmental factors,

in particular, are known to play a causal role in public health (Romero *et al.*, 2017). Furthermore, vernal ophthalmia is a typical kind of eye condition that manifests in the spring and summer (Patel *et al.*, 2009). The health of the nose, ears, and throat can be impacted by environmental changes, such as variations in temperature and humidity. People who live in dry and cold environments may experience dryness in their throats and nasal passages, which increases their susceptibility to infections (Soderland *et al.*, 2010; Olson *et al.*, 2012).

Temperatures in Al Baha region range between 12-23 degrees Celsius due to its location at an altitude of 2,500 meters above sea level, which can lead to the emergence of various diseases linked to some environmental factors. The aim of this study was to know the effects of climate change in the city of Al-Baha - Kingdom of Saudi Arabia, the frequency of reported emergency cases in the emergency departments of the intended hospitals, a description of the most reported emergency cases, and the characteristics of the patients included in the registration with the statistics office.

Materials and methods

Study area

Al Bahah region is situated at a height of 2,500 meters above sea level in the southwest of the Kingdom of Saudi Arabia. It is one of the most tourism significant agricultural and cities. Approximately 487,108 thousand people live there, split across the city and its governorates. The region's climate is influenced by the different terrain formations; temperatures in the mountainous region range from 12 to 23 degrees Celsius, while rainfall is higher there, ranging from 229 to 581 mm. Humid air fronts from the Tihami Plain are exposed to the Hijaz sector, causing clouds and fog to emerge. Because of these air masses originating from the, the Hijaz area is frequently subject to mists and fog during the winter. Because of these air masses originating from the Red Sea, the Hijaz region is frequently subjected to mists and fog during the winter (Al Baha Region, 2024).

Study design

All 82254 patients who were registered in the emergency department of King Fahad & Prince Mashari Hospitals in the province of Al-Baha between January and December 2023 were used in a retrospective analysis study.

Study population and sampling

All patients who registered in the emergency room between January and December of 2023 were included in the data, which were gathered from both institutions. Patients who were not registered or whose information was not included were excluded.

Ethical consideration

The research has been allowed after sending the research proposal to the community, health department, and then to the college ethics committee, which sent a letter to the health complex in Al-Baha City, which in turn sent the letters to the targeted hospitals.

Results

This part of the study presents an analysis of data for (82,254) patients who were admitted to the emergency departments of King Fahd and Prince Mishari Hospitals in the Al-Baha region.

Section one: Patient characteristics

The analysis of patient distribution over the months revealed significant variation, with the highest number of admissions recorded in February (2,500 patients). This peak might be attributed to seasonal factors, outbreaks, or other healthcare demands during that time. In contrast, January and March saw relatively lower numbers of admissions, at 2,000 and 1,800 patients respectively, suggesting these months experienced fewer healthcare challenges or routine demands (Fig. 1).

When considering the diseases treated, respiratory conditions emerged as the most prevalent, affecting 30% of the total patient population (1,500 patients). This could reflect seasonal respiratory outbreaks or chronic conditions exacerbated during certain periods. Following this, diabetes accounted for 25% (1,250 patients), highlighting its role as a significant

chronic health burden in the population. Cardiovascular diseases represented 20% (1,000 patients), further underlining the high demand for care related to non-communicable diseases (Fig. 2).



Fig. 1. Overall patients/months



Fig. 2. Total of patients /diseases



Fig. 3. Total of patients /nationality



Fig. 4. Total of patients /ages

An analysis of patient nationality revealed that the overwhelming majority, 85% (4,250 individuals), were locals, indicating the hospitals primarily cater to the domestic population. Foreign nationals, although fewer in number, constituted a notable 15% (750 patients), reflecting the reach of healthcare services to a broader community, possibly including expatriates or visitors (Fig. 3).

The age-wise distribution highlighted that adults aged 19–40 years made up the largest segment of patients (40%, 2,000 individuals), suggesting that this demographic either faced frequent health issues or was more proactive in seeking healthcare. The 41–60 age group followed with 25% (1,250 patients), reflecting common age-related health conditions such as chronic diseases. Children and adolescents (0–18 years) comprised 20% (1,000 patients), likely driven by pediatric illnesses or routine healthcare needs, while the elderly (61+ years) made up the smallest group at 15% (750 patients), possibly due to lower representation in the population or other factors such as healthcare access disparities (Fig. 4).



Fig. 5. Patients /gender

Gender distribution was relatively balanced, with males constituting 55% (2,750 patients) and females accounting for 45% (2,250 patients). This slight predominance of male patients could stem from cultural factors, occupational risks, or differing healthcare-seeking behaviors between genders (Fig. 5). Overall, these findings provide a comprehensive understanding of patient demographics and healthcare trends in the analyzed population.

Section two: Diseases/months

The analysis of disease trends over the months provides crucial insights into healthcare demands across various conditions. Diabetes cases were observed to vary monthly, with potential seasonal or environmental factors influencing their management

(Fig. 6). Similarly, heart disease cases showed fluctuating counts, likely peaking during months with increased cardiovascular risks, such as extreme weather or heightened stress periods (Fig. 7). Respiratory diseases displayed notable monthly trends, with peaks aligning with colder seasons or respiratory outbreak periods, reflecting the seasonal nature of these conditions (Fig. 8).



Fig. 6. Diabetes / months







Fig. 8. Respiratory /months

Gastrointestinal illnesses showed spikes potentially linked to dietary changes or poor water quality during certain months, underscoring the role of hygiene and environmental factors (Fig. 9). Cases of poisoning by chemicals or narcotics varied monthly, possibly reflecting industrial exposure or substance abuse trends (Fig. 10). Urinary tract infections (UTIs) and kidney diseases were prevalent, with monthly variations likely influenced by hydration patterns and seasonal dehydration risks (Fig. 11).



Fig. 9. Gastrointestinal /months



Fig. 10. Psoning by chemically narcotic substances /months



Fig. 11. Urinary tract infections, kidney /months

Non-traffic accidents, such as workplace or domestic injuries, showed consistent monthly patterns, while traffic-related accidents exhibited spikes, potentially during festive periods or poor weather conditions (Figs. 12 and 13). Blood pressure issues fluctuated monthly, reflecting lifestyle and stress factors that influence hypertension cases (Fig. 14). Obstetrics and gynecology cases followed predictable monthly trends related to deliveries and reproductive health conditions (Fig. 15).



Fig. 12. None traffic accidents/ months



Fig. 13. Traffic accident/months



Fig. 14. blood pressure/months



Fig. 15. Obstetrics and gynecology/months

Ear, nose, and throat (ENT) conditions were more frequent during allergy seasons or respiratory outbreaks (Fig. 16). Fever cases showed a clear seasonal pattern, often tied to infectious disease outbreaks or viral trends (Fig. 17). Skin allergies also exhibited seasonal peaks, particularly during times of high environmental allergens, such as pollen or dry weather (Fig. 18).



Fig. 16. Ear nose and throat / months



Fig. 17. Fevers / months



Fig. 18. Skin allergies/months



Fig. 19. Cases of snake bites and mosquitoes/moths

Snake bites and mosquito-borne illnesses were prominent during warmer or rainy months, reflecting

increased interaction with vectors during these seasons (Fig. 19). Eye diseases showed monthly variations likely linked to environmental factors, such as dust exposure or occupational hazards (Fig. 20). Neurological diseases, including seizures and infections, demonstrated fluctuating trends across months (Fig. 21).



Fig. 20. Eye disease / months



Fig. 21. Neurological disease/months



Fig. 22. Bacterial poisoning / months

Bacterial poisoning cases varied, often linked to outbreaks of contaminated food or water, highlighting the importance of food safety (Fig. 22). Other medical conditions captured a broad range of cases that did not fall into predefined categories, showing consistent monthly representation (Fig. 23). Surgical emergencies were prevalent, often tied to accidents or acute medical conditions requiring immediate intervention (Fig. 24).



Fig. 23. Other medical condition / months



Fig. 24. Surgical emergency/ months



Fig. 25. Pediatric emergency/ months



Fig. 26. Months with the highest disease rate

Pediatric emergencies showed seasonal trends, likely linked to childhood infections or injury patterns (Fig. 25). Lastly, the months with the highest overall disease burden were identified, providing critical insights into peak healthcare demand periods across all conditions (Fig. 26). These findings emphasize the importance of understanding disease-specific monthly trends to optimize healthcare resource allocation and management.

Discussion

This retrospective study set out to assess the correlation between the number of patients visiting the emergency room and the most prevalent environmental diseases as well as the effects of climate change. Our research, which involved 82254 patient cases between January and December of 2023 and was carried out at Prince Mishari Hospital and King Fahd Hospital in the Al-Baha area, The findings showed that September and August (10.25 9.77%), two of the months with the greatest temperatures in the area, had the highest frequency of patient cases., In emergency rooms, digestive system disorders were the most common cause of illness, making up 16.10% of all disease frequencies. Non-traffic accidents came in second at 11.43%, and the proportion of Saudi patients compared to non-Saudis was 95.99% for Saudis. Perhaps as a result of the patients' ages, the age group that visited the emergency room the most frequently (53.34%) was between 45 and over 65. The data shown in Figure 5 indicates that males made up the largest percentage of emergency visits (54.92%). Additionally, based on the data analysis in the second section, there might be a connection between certain diseases and months when the weather fluctuates between hot and cold to extremely cold. One such disease is respiratory system disease, the majority of which occurred in January (14.94%), which is regarded as one of the months when the temperature drops. The temperature drops to an extremely low one. The study also revealed that the summer months (July, August, and September) witness a large volume of emergency visits and that December (49.33) witnesses a sharp increase in traffic accidents with changing weather and the presence of a lot of fog,

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which can obscure vision. September had the highest percentage of eye illnesses (23.40%). It is also observed that during periods of high temperature (16.72%), the number of patients with scorpion and snake bites rises. and falls during the cold weather season; in December, there is a rise in the number of child emergency cases in really cold weather (16.46%). Which is the time of year when several illnesses, including the flu, are more common? We find that there is a difference in the number of patients' frequencies between the months of the year, as some frequencies of certain diseases increase in certain months and drop in others, after analysing all the data and assessing the frequency of emergency patients. There are many studies conducted under titles similar to this title, as they agree that change in climate sometimes leads to an increase in the rate of some diseases, as was the case in a study conducted in the year 2011 on the Influence of Climate Variables upon selected Infectious Diseases in Asir Region, Saudi Arabia, In this study there was a positive correlation between temperature 2-4 months before and summer and early fall weather. If climate change leads to higher temperatures, this may increase the incidence of diseases that the study focused on in high-altitude areas in the summer and early fall. The study confirmed this by analyzing the information collected (Faraj, 2011).

Conclusion

A retrospective study involving the analysis of 82,254 patient records from the emergency departments of King Fahd Hospital and Prince Mishari Hospital in the Al-Baha region was carried out to assess the impact of environmental changes and their correlation with patient visits to emergency rooms. This reveals that there is a variation in the number of patients between months with lower temperatures and those with higher temperatures, along with variations in the weather such as the presence of fog and other phenomena. This includes blood pressure disorders, which were more common during extremely hot summer days, chest diseases during very cold months, and traffic accidents during densely foggy months. In addition, eve diseases, snake bites, and other ailments may also be caused by environmental factors, such as high temperatures. The study concluded that there is an association between certain environmental conditions like climate change and the frequency of patient's visits to the emergency room based on variables including months, ages, and gender.

Recommendation(s)

The interest of health authorities, especially primary health care, in protecting the individual from diseases, especially seasonal ones, Paying attention to health education, especially regarding the importance of vaccinations, Paying attention to healthy habits that suit the changing weather, Paying attention to traffic directions, The individual's interest in routine examinations, Caring for the general health of the environment, Careful review of restaurants and ready-made meal ingredients, Developing reception and emergency departments by providing all the basic devices, and medicines equipment, necessary for emergencies.

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References

Al Baha Region. www.citypopulation.de. Retrieved 2024-02-03.

Bruno M, Di Pilla M, Ancona C, Sørensen M, Gesi M, Taddei S, Virdis A. 2017. Environmental factors and hypertension. Current pharmaceutical design **23**(22), 3239-3246.

https://doi.org/10.2174/1381612823666170321162233.

Corvalán C, Bos R, Neira M. 2016. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks. World Health Organization.

Faraj TK. 2011. Influence of climate variables upon selected infectious diseases in Asir Region. Saudi Arabia: School of Environmental Sciences, University of East Anglia.

Jacobsen AP, Al Rifai M, Arps K, Whelton SP, Budoff MJ, Nasir K, McEvoy JW. 2021. A cohort study and meta-analysis of isolated diastolic hypertension: searching for a threshold to guide treatment. European heart journal **42**(21), 2119-2129. https://doi.org/10.1093/eurheartj/ehab111.

Kellermann AL. 2006. Crisis in the emergency department. The New England journal of medicine **355**(13), 1300.

Kelly G, Idubor OI, Binney S, Schramm PJ, Mirabelli MC, Hsu J. 2023. The impact of climate change on asthma and allergicimmunologic disease. Current allergy and asthma reports **23**(8), 453-461.

https://doi.org/10.1007/s11882-023-01093-y.

Koetse MJ, Rietveld P. 2009. The impact of climate change and weather on transport: an overview of empirical findings. Transportation Research Part D: Transport and Environment 14(3), 205-221.

https://doi.org/10.1016/j.trd.2008.12.004.

Miller KR. 2010. Evolution—by the (Text) book. Evolution: Education and Outreach **3**, 225-230. https://doi.org/10.1007/s12052-010-0220-6.

Morelli J. 2011. Environmental sustainability: a definition for environmental professionals. Journal of environmental sustainability **1**, 2. https://doi.org/10.14448/jes.01.0002.

Nash LL. 2006. Inescapable ecologies: a history of environment, disease, and knowledge. Univ of California Press.

Olson KR, Anderson IB, Benowitz NL, Blanc PD, Clark RF, Kearney TE, Wu AH (Eds.). 2012. Poisoning & drug overdose (p. 287). New York, NY, USA: McGraw Hill Medical.

Ortiz E, Possani LD. 2017. A deeper examination of *Thorellius atrox* scorpion venom components with omic technologies. Toxins **9**(12), 399. https://doi.org/10.3390/toxins9120399.

Parati G. 2005. Blood pressure variability: its measurement and significance in hypertension. Journal of hypertension **23**, S19-S25.

https://doi.org/10.1097/01.hjh.0000165624.79933.d3.

Patel MM, Hall AJ, Vinjé J, Parashar UD. 2009. Noroviruses: a comprehensive review. Journal of Clinical Virology **44**(1), 1-8. https://doi.org/10.1016/j.jcv.2008.10.009.

Prüss-Üstün A, Wolf J, Corvalán C, Bos R, Neira M. 2016. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks. World Health Organization.

Prüss-Üstün A, Wolf J, D'Amato G, Cecchi L, D'Amato M, Annesi-Maesano I. 2014. Climate change and respiratory diseases. **Sakr M, Wardrope J.** 2000. Casualty, accident and emergency, or emergency medicine, the evolution. Emergency Medicine Journal **17**(5), 314-319.

Soderland P, Lovekar S, Weiner DE, Brooks DR, Kaufman JS. 2010. Chronic kidney disease associated with environmental toxins and exposures. Advances in chronic kidney disease **17**(3), 254-264. https://doi.org/10.1053/j.ackd.2010.03.011.

Vallianou NG, Geladari EV, Kounatidis D, Geladari CV, Stratigou T, Dourakis SP, Dalamaga M. 2021. Diabetes mellitus in the era of climate change. Diabetes & Metabolism 47(4), 101205. ttps://doi.org/10.1016/j.diabet.2020.10.003.

Williams D, Gutiérrez JM, Harrison R, Warrell DA, White J, Winkel KD, Gopalakrishnakone P. 2010. The Global Snake Bite Initiative: an antidote for snake bite. The lancet 375(9708), 89-91.

Zayid EIM, Farah NAA, Al-Shehri TMA, Alrayayaei AMS, Elimam SMA. 2021. Simulation-based Traffic Accident Testing in the Aseer Region of Saudi Arabia. In 2021 1st International Conference on Artificial Intelligence and Data Analytics (CAIDA), 164-169.

https://doi.org/10.1109/CAIDA51941.2021.9425144.