Correlation of Weather Parameters with Hospital Admissions for Hypertension in a Cold City, Erzurum, Türkiye

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ABSTRACT

Objective: Hypertension was influenced by weather conditions and was often endangered by lower temperatures. Erzurum, one of the coldest cities in Turkey, should have a higher risk of having a higher proportion of hypertensive patients, which needs clarification. The aim of this study was to investigate the relationship between meteorological parameters and the number of hypertensive patients admitted to hospital.

Methods: A retrospective cross-sectional study was performed in a tertiary university hospital in Erzurum by archive scan, searching the patients admitted to the emergency department with the complaint of hypertension with ICD code I10 (Essential Hypertension) in 2019. The annual meteorological data of 2019 were obtained from the relevant institutions and statistically compared by Pearson's correlation test.

Results: The total number of hypertensive patients admitted in 2019 was 1333, with mean admissions 3.65 ± 2.7 per day, and mean age was 60.9 ± 14.0 years. The mean daily maximum temperature was 14.15 ± 11.25 ºC, minimum temperature was 1.70 ± 8.69 ºC, mean actual pressure was 813±4.3 hPa, mean relative humidity was 59.7 ± 17.7%. The number of hypertensive admissions had a significantly negative correlation with daily maximum temperature, minimum temperature and actual pressure, but a positive correlation with relative humidity ($r=-.244$, $p<0.001$; $r=-.211$, $p<0.001$; $r=-.308$, $p<0.001$, $r=.203$, $p<0.001$; respectively).

Conclusion: Hypertensive patients were found to be more vulnerable at lower temperatures, lower actual air pressure and higher relative humidity. They need to monitor weather changes and take preventive action.

Keywords: Weather, hypertension, cold, temperature, humidity, preventive care, hospital admission

INTRODUCTION

Cold-induced peripheral vasoconstriction is an important reaction in the regulation of body temperature. Sympathetic noradrenergic vasoconstrictor nerves cause a rapid decrease in cutaneous blood flow, increasing the insulating capacity of the skin and reducing heat loss from the body (1, 2). Exposure to cold weather increases blood pressure and can worsen symptoms and affect the prognosis of people diagnosed with hypertension, which can adversely affect left cardiac function and increase cardiovascular events (3). Therefore, people living in cold cities are at risk of developing hypertension. Cold can also worsen cardiorespiratory symptoms in hypertensive patients, highlighting the need for careful monitoring of hypertensive patients on cold days (4). Interestingly, the pregnant women who lived in cold cities and were exposed to cold weather during pregnancy were more likely to have hypertensive offspring later in life (5). These studies reflect the possible association of the hypertension with the cold weather parameters. However, other parameters followed in daily meteorological routine may have some health effects and need to be identified.

Erzurum is located in the eastern part of Turkey and is a cold city with an average annual temperature of just 5.8°C (41°F) (6). As hypertension was influenced by weather conditions and was often threatened by low temperatures, and Erzurum is one of the coldest cities in Turkey, there should be a higher risk of having a higher proportion of hypertensive patients, which needs to be clarified.

The aim of this study was to investigate the relationship between meteorological parameters and the number of patients admitted to the emergency department of a university hospital with the complaint of hypertension in one of the coldest cities, Erzurum, Türkiye.

METHODS

A retrospective cross-sectional study was performed. The study was designed as an archive scan, using only patients' daily admission numbers and the daily weather parameters. In this respect, the patient identifiers, the laboratory or test values, the clinical history and the specific or demographic variables of the patients were not collected or used. This study is therefore not subject to ethical approval and does not require informed consent from patients.

The study was conducted in Erzurum, one of the coldest cities in Türkiye, at Atatürk University Hospital, one of the only two state hospitals in the city. Patients aged 18 years or older who were admitted to the emergency department in 2019 with a complaint of high blood pressure and were diagnosed with an ICD-10 code of I10 (Essential Hypertension) were included in the study. The number of such patients was recorded on a daily basis. Hospital admission data were chosen from 2019 to avoid some confounding factors, especially as of 2020 the number of patients may be changed due to the COVID-19 pandemic. The possible relationship of hypertension with current or past history of COVID-19 disease.

The annual meteorological data were obtained from the General Directorate of Meteorology, which has been collecting all official climate statistics as daily parameters in all cities of Türkiye since 1923. The data of Erzurum for 2019 including daily maximum temperature, daily minimum temperature, daily relative pressure and relative humidity were collected. Pearson's correlation test was used to statistically analyze these meteorological parameters with the number of hospital admissions of patients with hypertension using SPSS V27 (IBM, USA).

RESULTS

The total number of patients admitted to the Emergency Department of Atatürk University Hospital with the complaint of hypertension in 2019 was 1333, with an average of 3.65±2.7 admissions per day. The monthly emergency department admissions for hypertension are given in Figure 1.

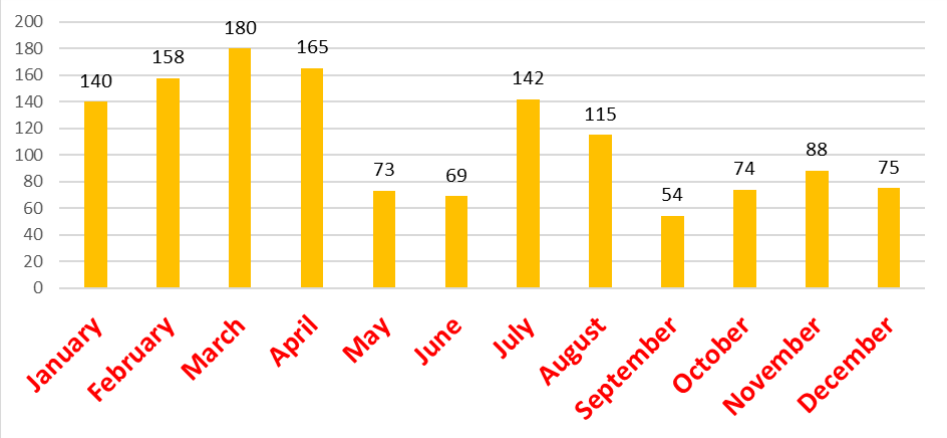

Figure 1. Number of hospital admissions per month for hypertension in 2019.

In 2019, the mean daily maximum temperature was observed as 14.15 ± 11.25 ºC, the minimum temperature was 1.70 ± 8.69 ºC, the mean actual pressure was 813 ± 4.3 hPa, and the mean relative humidity was 59.7 ± 17.7% (Table 1).

The correlations between the daily number of admissions and the daily weather parameters are shown in Table 2. Accordingly, the number of emergency admissions for hypertension was significantly negatively correlated with daily maximum temperature, minimum temperature, and actual pressure, but positively correlated with relative humidity (daily maximum temperature: r = -.244, p<0.001; daily minimum temperature: r = -.211, p<0.001; daily actual pressure: r = -.308, p<0.001; and the relative humidity: r = .203, p<0.001).

Table 1. Average daily emergency department admissions for hypertension and average daily weather variables in 2019.

		Hypertension Patient Count	Maximum Daily Temperature	Minimum Daily Temperature	Daily Actual Pressure	Daily Relative Humidity
Mean		3.65	14.15	1.7	813	59.71
95% Confidence Interval for Mean	Lower Bound	3.37	12.99	0.8	812.56	57.89
	Upper Bound	3.93	15.31	2.59	813.44	61.53
Median		3	14.3	1.5	813.2	59.5
Standard Deviation		2.7	11.25	8.69	4.27	17.71
Minimum		0	-10.8	-20	797	24.8
Maximum		16	34.9	19.4	825.5	96.7
Interquartile Range		3	20.9	14.15	5.2	29.8

Table 2. Correlations between weather parameters and the number of patients admitted to hospital with hypertension.

		Maximum Temperature	Minimum Temperature	Actual Pressure	Relative Humidity
Hypertension Patient Count	Pearson Correlation	-.244**	-.211**	-.308**	.203**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	365	365	365	365

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

Hypertension is a complex health condition influenced by a variety of factors, including genetics, lifestyle and environmental factors. While the direct causal relationship between hypertension and relative air humidity, temperature and air pressure remain an area of ongoing research, the possible links need to be identified. Our study focused on this possible aggravating effect of weather conditions on blood pressure and found that cold air temperature, low air pressure and high humidity were statistically associated with hypertensive emergency admission rates.

A study published in the journal Hypertension found that lower average temperatures and higher relative humidity were associated with higher blood pressure and difficulty controlling high blood pressure (7). The study results were found to be parallel and support our findings.

A study investigating the effects of exposure to fine particulate matter (PM2.5), known to be one of the main air pollutants with adverse health effects, on blood pressure found detrimental effects of short-term PM2.5 exposure on hypertension (8). Moreover, long-term exposure to PM2.5 was also found to be linked to high blood pressure (9). These studies reflect the possible health effects of air pollutants on hypertension, which is mostly a consequence of indoor fuel consumption, especially in cold cities. In this context, a meta-analysis study focused on the possible benefits of home particulate air filtration on blood pressure and found a significant reduction in systolic blood pressure, but not diastolic blood pressure (10). Therefore, some other environmental parameters may play a role in hypertension in addition to particulate matter. In this regard, one study found a co-occurrence of low temperature and high PM2.5 with a highly increased likelihood of morning hypertension (11). As Erzurum is known to have higher PM2.5 levels (12) and is a notoriously cold city (6), Erzurum is more prone to hypertension attacks, particularly in the winter months, as seen in our study.

The relationship between air relative humidity, air temperature, and air pressure and hypertension is complex and not fully understood, these environmental factors may contribute to blood pressure fluctuations in some individuals.

CONCLUSION

Weather changes have implemental effects on health. Hypertensive patients were found to be vulnerable with the lower temperature, lower actual air pressure and with higher relative humidity. They need to follow the changes in weather and adopt preventive approaches.

DECLARATIONS

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Conflict of Interest Statement: There are no potential conflicts of interest to declare.

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

REFERENCES

1. Alba, Billie K., John W. Castellani, and Nisha Charkoudian. Cold-induced cutaneous vasoconstriction in humans: Function, dysfunction and the distinctly counterproductive. Experimental Physiology. 104.8 (2019): 1202-1214. https://doi.org/10.1113/EP087718.
2. Greaney JL, Kenney WL, Alexander LM. Neurovascular mechanisms underlying augmented cold-induced reflex cutaneous vasoconstriction in human hypertension. J Physiol. 2017 Mar 1;595(5):1687-1698. https://doi.org/10.1113/JP273487.
3. Chen R, Yang Q, Wang Y, Fang Y, Cao F. Association between baseline blood pressure variability and left heart function following short-term extreme cold exposure." The Journal of Clinical Hypertension 26.8 (2024): 921-932. https://doi.org/10.1111/jch.14862.
4. Ikäheimo TM, Lehtinen T, Antikainen R, Jokelainen J, Näyhä S, Hassi J, Keinänen-Kiukaanniemi S, Laatikainen T, Jousilahti P, Jaakkola JJ. Cold-related cardiorespiratory symptoms among subjects with and without hypertension: the National FINRISK Study 2002. Eur J Public Health. 2014 Apr;24(2):237-43. https://doi.org/10.1093/eurpub/ckt078.
5. Li N, Cai L, Heizhati M, Wang L, Li M, Zhang D, Abulikemu S, Yao X, Hong J, Zou B, Zhao J. Maternal exposure to cold spells during pregnancy is associated with higher blood pressure and hypertension in offspring later in life. J Clin Hypertens (Greenwich). 2020 Oct;22(10):1884-1891. https://doi.org/10.1111/jch.14015.
6. General Directorate of Meteorology. Official Climate Statistics. Seasonal normals for Erzurum. [Internet] Last Accessed at: 02.10.2024. https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ERZURUM.
7. Xin C, Zhe H, Jiguang W. Influence of average air temperature, pressure and air relative humidity on blood pressure. Journal of Hypertension 41(Suppl 1):p e244, January 2023. https://doi.org/10.1097/01.hjh.0000915216.02267.3c.
8. Lin Z, Wang X, Liu F, Yang X, Liu Q, Xing X, Cao J, Li J, Huang K, Yan W, Liu T, Fan M, Li W, Chen S, Lu X, Gu D, Huang J. Impacts of Short-Term Fine Particulate Matter Exposure on Blood Pressure Were Modified by Control Status and Treatment in Hypertensive Patients. Hypertension. 2021 Jul;78(1):174-183. https://doi.org/10.1161/HYPERTENSIONAHA.120.16611.
9. Bo Y, Guo C, Lin C, Chang LY, Chan TC, Huang B, Lee KP, Tam T, Lau AKH, Lao XQ, Yeoh EK. Dynamic Changes in Long-Term Exposure to Ambient Particulate Matter and Incidence of Hypertension in Adults. Hypertension. 2019 Sep;74(3):669-677. https://doi.org/10.1161/HYPERTENSIONAHA.119.13212.
10. Walzer D, Gordon T, Thorpe L, Thurston G, Xia Y, Zhong H, Roberts TR, Hochman JS, Newman JD. Effects of Home Particulate Air Filtration on Blood Pressure: A Systematic Review. Hypertension. 2020 Jul;76(1):44-50. https://doi.org/10.1161/HYPERTENSIONAHA.119.14456.
11. Imaizumi Y, Eguchi K, Kario K. Coexistence of PM2.5 and low temperature is associated with morning hypertension in hypertensives. Clin Exp Hypertens. 2015;37(6):468-72. https://doi.org/10.3109/10641963.2015.1013117.
12. Bayraktar H, Turalioglu FS, Tuncel G. and Zararsiz A. Elemental Composition of PM10 and PM2.5 in Erzurum Urban Atmosphere, Turkey. Fresenius Environ. Bull. 2011;20: 1124–1134.