



Aneurysms in the Times of the Climatic Change [†]

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[†] Presented at the 16th International Conference on Meteorology, Climatology and Atmospheric Physics—COMECAP 2023, Athens, Greece, 25–29 September 2023.

Abstract: The effects of climate change are now evident on a global level and indisputable even to the most skeptical. Melting ice, rising sea levels, and changing climate zones are a daily occurrence and subject of debate in the media. Beyond the obvious effects of these phenomena on human lives, countless others arise and await being studied. Meanwhile, it has been proven that many health problems are related to changes in weather and large fluctuations of temperature. Specifically, studies have been conducted to correlate the rupture of intracranial aneurysms with seasonal and climatic conditions. The conclusions of these studies linked the rupture of intracranial aneurysms with higher temperatures, as well as with higher atmospheric pressure. Inevitably, one of the questions raised is whether the change in weather brings about conditions that favor the rupture of intracranial aneurysms throughout the year. The purpose of this paper is to present the results of studies that correlate these two factors and, then, to demonstrate that these meteorological conditions now prevail throughout the year, influencing, perhaps, and distributing the rupture of intracranial aneurysms during all seasons.

Keywords: aneurysm; climate change; health; intracranial; rupture



Citation: Karagianni, E.; Karagianni, A. Aneurysms in the Times of the Climatic Change. *Environ. Sci. Proc.* **2023**, *26*, 29. <https://doi.org/10.3390/environsciproc2023026029>

Academic Editors: Konstantinos Moustiris and Panagiotis Nastos

Published: 23 August 2023



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1. Introduction

The term climate change refers to changes in the climate on a global scale and, in particular, to the change in weather conditions, which extend over time. It is undeniable that our planet is experiencing this change, the consequences of which are flooding the media every day. We have all been in awe at the sight of huge icebergs melting and sea levels rising as a result, while weather conditions plague the world with extreme temperatures. Winters are characterized by extremely cold temperatures, with the recent bomb cyclone in the U.S., with extremely cold temperatures, freezing air currents, and freezing rain claiming many lives, as a prime example [1]. At the same time, heat waves in the summer create unbearable conditions for many people, while fires break out that cannot be extinguished due to the high temperatures, further destroying nature and disrupting the climate [2].

The effects of extreme temperatures on human health are obvious. What are the consequences of the general change in temperature and of the change in barometric pressures over the course of a year? There are, perhaps, more than we can think of. Changes in climate have been associated with numerous health effects, including cardiovascular disease, respiratory disease, and infectious disease. The relationship between climatic changes and the rupture of intracranial aneurysms is a topic of growing interest. The purpose of this article is to review the effect that climate changes could have on the rupture of intracranial aneurysms.

An intracranial aneurysm is a swelling in a blood vessel in the brain. Intracranial aneurysms occur at a high frequency, in about 4% of the population, and their symptoms are not always noticeable or, even, non-existent. The real danger that lurks, however, is the

subarachnoid hemorrhage which is caused by their rupture. This rupture occurs violently, without warning, and can be fatal [3]. The extremely high frequency of occurrence of aneurysms, combined with their dangerousness, their morbidity, and mortality, makes it imperative to understand the risk factors that are associated with them.

2. The Association between Weather Conditions and the Rupture of Intracranial Aneurysms

Beyond the risk factors that are known to cause the rupture of intracranial aneurysms, such as smoking, high blood pressure, and family history, studies have been dedicated to identifying the impact of weather conditions on it. Climatic change can affect the human body in several ways, including changes in temperature, humidity, and air pressure. These changes can have an impact on the cardiovascular system, including on blood pressure and heart rate, which are factors that are believed to be involved in the pathogenesis of intracranial aneurysms [4].

2.1. Temperature

Temperature is a critical climatic factor that affects the human body. High temperature has been associated with increased blood pressure and heart rate, which are factors that are believed to be involved in the pathogenesis of intracranial aneurysms. Hemodynamic stress on the arterial walls is one of the major factors that contribute to the development and rupture of intracranial aneurysms. High temperature can also increase blood viscosity, which can cause an increase in blood pressure and heart rate, leading to hemodynamic stress on the arterial walls. This increased stress can weaken the arterial walls and increase the risk of intracranial aneurysm rupture. Several studies have shown that intracranial aneurysms are most likely to rupture during the seasons of autumn or spring [5–7], and even more in summer, when the weather is the hottest.

A study conducted in Korea also reported an increased incidence of subarachnoid hemorrhage caused by ruptured intracranial aneurysms during the summer months, which were characterized by high temperatures. The study found that there was a 2.3% higher risk of subarachnoid hemorrhage caused by ruptured intracranial aneurysms per 1 °C increase in mean monthly diurnal temperature [8].

The association between high temperatures and the rupture of intracranial aneurysms has also been observed in other parts of the world. For example, a study conducted in Beijing found that the incidence of ruptures of intracranial aneurysms was higher in seasons with higher average temperatures. The study also reported that it was higher in seasons with more significant temperature variations [9].

2.2. Air Pressure

Air pressure is another climatic factor that can affect the human body. Changes in air pressure can affect blood pressure and heart rate, which are factors that are believed to be involved in the rupture of intracranial aneurysms. This is supported by the fact that autumn and spring are the seasons that are more often associated with migraine headaches due to changing weather patterns and changing barometric pressure [10]. The barometric pressure can cause the tissues to expand or contract, a phenomenon which is more intense during these seasons, as the barometric pressure tends to fluctuate. It is higher during cold weather, as the air is denser and adds more pressure, while it is lower when the air is hotter and expanding, which makes it lighter. The temperature in autumn and spring is quite unpredictable, with many ups and downs, compared to the more stable temperatures in winter and summer. This constant fluctuation causes the migraine headaches and might be the explanation of the rupture of aneurysms being triggered.

2.3. Humidity

Humidity is another climatic factor that can affect the human body. High humidity can cause discomfort, and it has been suggested that it can also increase the risk of cardiovascu-

lar disease. However, the relationship between humidity and the rupture of intracranial aneurysms is not well understood.

A study found that the incidence of subarachnoid hemorrhage was higher during the months characterized by higher temperatures and higher relative humidity. Specifically, the study reported that the risk of subarachnoid hemorrhage was higher by 39% in males on days with an increase in relative humidity by 17.6% [11]. It is possible that high humidity may increase blood pressure and promote the development of cerebral aneurysms, which could contribute to the increased risk of subarachnoid hemorrhage.

3. Weather Conditions Changing Due to Climate Change

In the last decades, climate change has been transforming weather patterns globally. Year by year, we are witnessing the effects of this change on our daily lives. Climate change is causing the Earth's temperature to increase. Human activities such as burning fossil fuels, deforestation, and industrial processes release large amounts of greenhouse gases, particularly carbon dioxide, into the atmosphere. These greenhouse gases trap heat in the Earth's atmosphere, preventing it from escaping into space and causing a warming effect known as the greenhouse effect [12]. As the concentration of greenhouse gases in the atmosphere increases, the amount of heat trapped also increases, causing the Earth's temperature to rise. This rise in temperature is resulting in a range of impacts on the climate system, including changes in precipitation patterns, sea level rise, and more frequent and intense heat waves, droughts, and extreme weather events. Moreover, the warming of the Earth's surface also affects other important aspects of the climate, such as ocean currents, cloud cover, and the water cycle, which can further amplify the impacts of climate change.

According to NASA's Goddard Institute for Space Studies (GISS), the Earth's temperature has increased by at least 1.1° Celsius since 1880 [13]. Although the Earth's temperature is rising, we have been experiencing extremely cold winters with heavy snowfalls. According to the Environmental Defense Fund, although this seems contradictory, it is completely explainable, as the large amounts of waters that are being vaporized due to temperatures rising are bound to fall back to earth through heavy snowfalls [14]. This explains the phenomena that are repeatedly reported in the media throughout the year, such as floods, blizzards, snowstorms, and bomb cyclones that take many lives every year.

As the Earth's temperature rises due to increased greenhouse gas emissions, the temperature of the air also increases. As explained above, warm air is less dense than cold air, so the warmer air can cause changes in air pressure patterns. Furthermore, as sea levels rise due to melting ice caps and glaciers, the weight of the water on the Earth's surface can cause changes in air pressure patterns. This can affect weather patterns and ocean currents, which can in turn impact the climate [15]. Climate change can also affect precipitation patterns, which can impact air pressure. For example, changes in rainfall patterns can lead to changes in soil moisture and vegetation, which can affect the amount of water vapor in the atmosphere [16].

In conclusion, climate change results in temperature, air pressure, and humidity rises and fluctuations. All these factors are associated with the rupture of intracranial aneurysms, which will become even more frequent as the environment goes out of control.

4. Discussion

The constant changing of the weather conditions due to climate change will create a "temperature roller-coaster", as there will be extreme variations between extremely high and low temperatures [17]. The seasons of the year are vanishing, with autumn and spring being nonexistent as separate seasons, but instead being part of a larger portion of the year with vague boundaries between winter and summer, or even disrupting these. As a result of these temperature swings, the barometric pressure and humidity that are directly associated with the air temperature will fluctuate as well.

These extreme temperature swings will have the same effects on people, or even worse, as the fluctuations that take place in autumn and spring. The expansion and contraction of

the tissues will be caused in a more frequent and violent way, all year round, causing more migraine headaches and ruptures of intracranial aneurysms.

5. Conclusions

The effects of climate change on human health are multifaceted and we are yet to discover a wide range of them; hopefully this will happen in time to help humanity deal with them. Climate change is having a significant impact on human health, with a range of effects already being observed and projected to worsen in the coming decades. Heat waves, extreme weather events, and increased air pollution are among the most prominent risks to human health associated with climate change.

At the same time, the rupture of intracranial aneurysms is a common health problem with a high mortality. According to the Brain Aneurysm Foundation, up to 50% of people who experience a subarachnoid hemorrhage die within the first few days, while 15% will die before reaching a hospital. For those who survive a subarachnoid hemorrhage, there is still a risk of long-term complications such as cognitive impairment, physical disability, and seizures [18]. Therefore, early detection and treatment of intracranial aneurysms is crucial to improving patient outcomes and reducing mortality rates.

As climate change and intracranial aneurysms are constantly reaping lives, the link between them ought to be researched in depth, as it might equip us with the knowledge to defeat these two enemies of human kind by leading to hospital preparedness and prevention.

Author Contributions: Conceptualization, E.K. and A.K.; methodology, E.K. and A.K.; software, E.K.; validation, E.K. and A.K.; formal analysis, E.K. and A.K.; investigation, E.K. and A.K.; resources, E.K. and A.K.; data curation, E.K. and A.K.; writing—original draft preparation, E.K. and A.K.; writing—review and editing, E.K.; visualization, E.K.; supervision, E.K.; project administration, E.K.; funding acquisition; not applicable. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable. All data have been sourced from bibliographic references.

Informed Consent Statement: Not applicable. All data have been sourced from bibliographic references.

Data Availability Statement: The data presented in this study are available in the bibliographic references.

Conflicts of Interest: The authors declare no conflict of interest.

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