

## THE IMPACT OF METEOROLOGICAL FACTORS ON MENTAL HEALTH

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### Summary

Climate change and the increasing frequency of extreme weather events are increasing interest in the impact of environmental factors on health, especially mental health. The study aims to analyze the impact of meteorological factors on mental health. A narrative analysis of scientific literature was conducted, reviewing articles on the links between air temperature, humidity and extreme weather events with mental health indicators. It was found that higher temperatures and heat waves are associated with greater distress, symptoms of depression and anxiety, more frequent hospitalizations and a higher risk of suicide. It was found that air humidity can enhance the effects of heat. These relationships are explained through biological and physiological mechanisms. Changes in temperature, atmospheric pressure and humidity cause the body's stress response and activation of the autonomic nervous system. As a result, serotonin regulation, circadian rhythms and the amount of stress hormones such as cortisol change, which directly affects the emotional state and can lead to the development of depression, anxiety, mood swings and sleep disorders.

**Keywords:** air temperature, humidity, atmospheric pressure, impact, mental health.

### Introduction

Climate change and accelerating environmental changes are becoming one of the most important challenges of modern society, affecting not only physical but also mental health of people. In recent decades, increasing attention has been paid to the impact of meteorological factors, such as air temperature, humidity or extreme weather events, on a person's emotional state and the prevalence of mental disorders. Scientific research shows that environmental changes caused by climate change can increase psychological stress, anxiety and symptoms of depression (Berry et al., 2010; Clayton, 2020).

The increasing frequency of extreme weather events, particularly heat waves, is associated with negative mental health outcomes in various populations. It has been found that high temperatures can affect human behavior, emotions, and cognitive functions, increase hospitalizations for mental disorders, and worsen overall psychological well-being (Obradovich et al., 2018). In addition, higher temperatures are associated with a higher risk of suicide (Burke et al., 2018). Factors such as humidity and atmospheric pressure fluctuations can also amplify the effects of temperature by affecting physiological processes in the body (Basu & Samet, 2002).

The impact of meteorological factors on mental health may be related to various biological and physiological mechanisms that are observed in the development or exacerbation of mental disorders. High air temperature can disrupt the body's thermoregulation, affect sleep quality, hormonal balance and neurotransmitter activity (Rony et al., 2023). Sleep disorders are considered an important risk factor for depression, anxiety and worsening of emotional state. In addition, changes in sunlight can affect serotonin metabolism in the brain, which is important for mood regulation (Lambert et al., 2002).

Recent research also suggests that exposure to high temperatures is associated with increased mental health risks. Exposure to high temperatures was found to be associated with a 13% higher risk of hospitalization or visit to a mental health professional, an 18% higher risk of depression, and a 12% higher risk of general mental health problems compared to lower temperatures (Lai et al., 2026). These results suggest that meteorological factors may be significant not only for general emotional well-being, but also for the risk of specific mental health conditions.

This study examines not only how meteorological factors, such as air temperature, relative humidity and extreme weather events, affect people's psychological state, but also what biological and physiological mechanisms explain these effects. While previous studies have extensively investigated the impact of individual environmental factors on mental health, the aim of this study was to comprehensively assess their influence on emotional state and potential risk of mental health disorders.

Thus, despite growing evidence of the impact of environmental factors, the impact of meteorological factors on mental health is still not sufficiently assessed in a public health context. Mental health disorders are one of the causes of the global burden of disease, and environmental factors, especially climate change, may indirectly exacerbate this situation (World Health Organization, 2022). Since vulnerable population groups, such as those with chronic diseases, mental health disorders, older people and those with disadvantaged socio-economic status, may be more sensitive to environmental changes, it is important to understand how environmental factors, including meteorological conditions, may contribute to mental health outcomes. All this is useful both for the pursuit of scientific knowledge and for prevention purposes. In addition, the study is distinguished by the fact that it combines scientific data from different periods and systematizes the latest research results related to the context of climate change. In this way, it aims not only to summarize existing knowledge, but also to highlight new trends related to the increasing frequency of extreme meteorological events and their impact on mental health.

The relevance of this topic is particularly important in the fields of environmental sciences and public health, as environmental changes caused by climate change are becoming a significant risk factor for public health. Environmental scientists analyze climate change processes, the increase in the frequency of meteorological phenomena and their impact on the environment and people, while public health specialists assess the impact of these changes on the health of the population and develop preventive measures to reduce negative consequences. The increasing frequency of extreme meteorological phenomena and their connection with mental health problems indicate the need to apply an interdisciplinary approach that combines environmental, climate and public health knowledge. The results of this study may be important in planning public health strategies, developing early prevention measures and contributing to reducing the impact of climate change on the mental health of the population.

**The object of the study** is the impact of meteorological factors (air temperature, humidity and extreme weather events) on mental health (hospitalization frequency, stress, mood).

**The aim of the study** is to analyze the impact of meteorological factors (air temperature, humidity and extreme weather events) on mental health.

**Problematic questions:** How do meteorological factors affect people's mental health? What biological and physiological mechanisms explain the impact of meteorological factors on mental health?

**Applied methods:** a scientific narrative literature analysis was conducted to review the impact of meteorological factors on mental health.

## 1. Research methodology

The study used a narrative literature review methodology. The search for scientific sources was conducted using two main databases – PubMed and ScienceDirect. The following keywords in English were selected for the search: meteorological factors, air temperature, humidity, atmospheric pressure, impact, mental health.

The articles included in the analysis were selected according to the following criteria: publication period from 2002 to 2025, peer-reviewed scientific articles, empirical and clinical studies. The articles were also assessed for their relevance to the research topic – the impact of meteorological factors on mental health.

A total of 9 scientific articles were included in the literature review. The selected studies were conducted in different geographical regions, including the United States, Mexico, Europe (Spain), and Australia, representing different climatic conditions and population groups. The studies analyzed included a variety of sample types, including general population data, patient cohorts, and national

population-based datasets. This diversity of study settings allowed for a broader assessment of the relationship between meteorological factors and mental health outcomes in different environmental contexts (Table 1).

The collected data were analyzed using a thematic analysis of scientific publications. The results obtained were summarized by conducting an analytical review, on the basis of which data-based conclusions were formulated. The thematic analysis focused on identifying relationships between meteorological factors (air temperature, humidity and extreme weather events) and mental health indicators, including hospitalization frequency, emotional state, stress, anxiety, depression symptoms, sleep disturbances and suicide risk.

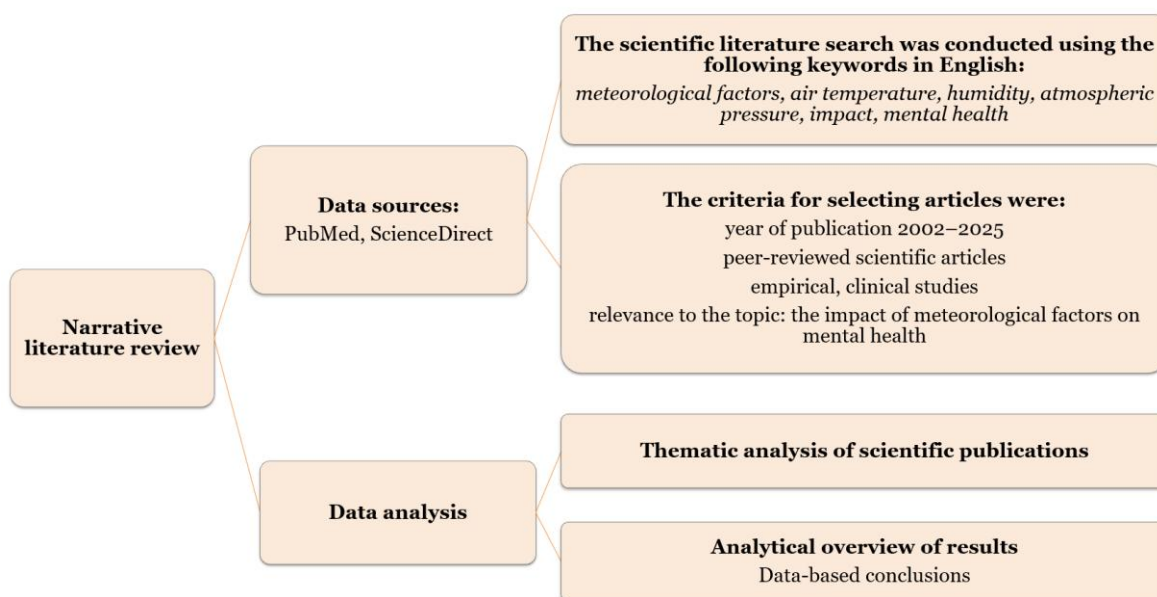
**Table 1. Characteristics of analyzed studies**

*Source: compiled by the authors*

Author	Country/Region	Climate zone	Study population	Sample size	Main findings
Mullins and White, 2019	United States	Multiple climate zones	General population	2 million individuals	Increased prevalence of mental health disorders associated with higher temperatures
Burke et al., 2018	United States and Mexico	Multiple climate zones	National population data	Millions of observations from national datasets	Increased suicide risk associated with higher temperatures
Anderson et al., 2000	United States	Not specifically defined / multiple regions	General population	Review of multiple studies	Higher temperatures associated with increased aggression
Keller et al., 2005	United States	Temperate climate region	Adults	605 participants	Weather conditions associated with mood and cognitive changes
Bulanova et al., 2005	Spain	Mediterranean climate	Patients with panic disorder	30 participants	Weather changes associated with anxiety symptoms
Lambert et al., 2002	Australia	Temperate to subtropical climate	Adults	101 participants	Seasonal changes associated with serotonin turnover
Mills et al., 2018	United States	Multiple climate zones	National sample	12,400 participants	Meteorological conditions associated with cortisol changes
Obradovich et al., 2017	United States	Multiple climate zones	General population	765,000 individuals	Higher nighttime temperatures associated with sleep disturbances

\*Multiple climate zones – used large-scale US data from different states

The study design is presented in the first figure.



**Figure 1. Study design**

*Source: compiled by the authors*

## 2. The impact of meteorological factors on mental health

In recent years, the impact of meteorological factors on mental health has been increasingly studied in empirical studies that reveal statistically significant relationships between environmental conditions and indicators of mental disorders. One of the most studied factors is air temperature. It has been found that the number of hospitalizations for mental and behavioral disorders increases with increasing air temperature. For example, a large-scale epidemiological study in the USA showed that higher temperatures are associated with a significant exacerbation of mental health disorders and a higher frequency of hospitalizations (Mullins and White, 2019). However, it is important to note that these relationships are not unambiguous in all populations, as their strength may be determined by sociodemographic factors. In addition, it has been found that high temperatures affect not only the frequency of hospitalizations, but also emotional state and behavior. Empirical data show that heat waves are associated with increased aggression, irritability and cognitive dysfunction (Anderson et al., 2000).

Recent studies also show that an increase in air temperature is associated with an increased number of suicides. Long-term analyses show that even small changes in air temperature can lead to higher suicide rates. A 1°C increase in average air temperature has been found to be associated with an approximately 0.7% increase in suicide rates in the United States and 2.1% in Mexico (Burke et al., 2018). These results suggest that even small changes in temperature can be associated with significant changes in mental health indicators. However, such results should be interpreted with caution, as suicide risk is determined by many factors that act in a complex way. The meteorological aspect of the taiga is only one part of a complex phenomenon.

In the context of environmental factors, air temperature is not the only factor considered when assessing the impact on mental health. Increasing attention is also being paid to other meteorological factors, such as relative humidity and atmospheric pressure. Although the impact of these factors is less analyzed, some scientific studies have shown that higher relative humidity can enhance the effects of heat and affect the human body, thus indirectly affecting mental health (Dixon et al., 2020). Studies also show that fluctuations in atmospheric pressure are associated with emotions, mood changes and increased anxiety (Keller et al., 2005).

Summarizing the scientific literature, it can be stated that meteorological factors, such as air temperature and extreme events, affect mental health by increasing stress, worsening mood, and increasing the number of hospitalizations. However, this effect is complex, complicated, and can be influenced by other factors.

### 3. Biological and physiological basis of the impact of meteorological factors on mental health

The explanation of the impact of meteorological factors on mental health is based on biological and physiological mechanisms, such as activation of the autonomic nervous system, hormonal regulation and imbalance of neurotransmitters. Air temperature, relative humidity, atmospheric pressure and wind speed can affect the human body through these interrelated mechanisms, which can manifest as psychological symptoms, anxiety, depression, sleep disorders and mood swings (Figure 2).

One of the most important mechanisms is the body's reaction to fluctuations in air temperature, which subsequently triggers a stress response and activates the sympathetic nervous system. Studies show that high air temperature increases this physiological stress and thus causes an imbalance of the autonomic nervous system, which can lead to mood and anxiety disorders (Bulanova et al., 2005).

The human neuroendocrine system, including cortisol secretion, is also very important. Studies show that meteorological conditions, especially air temperature and relative humidity and their changes, can affect cortisol, the main stress hormone, and increase its levels. Elevated cortisol levels negatively impact a person's psychological and emotional state and may increase the risk of depression and anxiety disorders over time (Mills et al., 2018). However, it is important to understand that the effects of these factors are also determined by individual susceptibility and adaptation, as well as other circumstances that can cause stress.

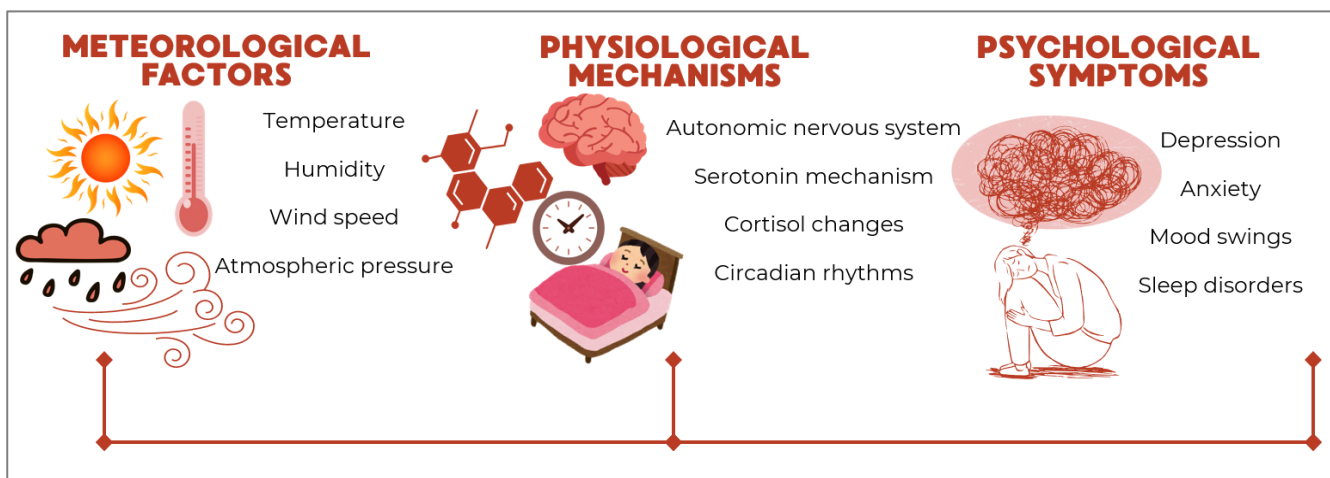


Figure 2. Links between meteorological factors, physiological mechanisms and psychological symptoms

Source: compiled by the authors

The mechanism of changes in serotonin regulation is also closely related to the control of human mood. Studies show that meteorological factors, including ambient air temperature and light intensity, can affect serotonin activity in the central nervous system and even influence the development of depression (Lambert et al., 2002). This explains why seasonal weather changes are associated with emotions and mood swings.

Of particular importance is the effect of circadian rhythm disruption, which often occurs in conjunction with temperature fluctuations. Empirical studies have shown that higher nighttime air temperatures can worsen sleep quality and even shorten sleep duration. This is directly related to increased emotional instability and may also affect the risk of mental health disorders (Obradovich et al., 2017).

Empirical studies have shown that higher night-time temperatures are associated with shorter sleep duration it is estimated that people lose an average of 44 hours of sleep per year due to increased night-time temperatures (Obradovich et al., 2017). Deterioration in sleep quality may contribute to changes in emotional state and increase the risk of mental health disorders.

The studies analyzed also showed that the magnitude of the impact of meteorological factors may vary depending on the geographical region and climatic conditions. For example, Burke et al. (2018) found that a 1 °C increase in temperature was associated with a 0.7% increase in suicide rates in the United States and a 2.1% increase in suicide rates in Mexico. These differences may be related to different climatic conditions, population adaptation to environmental factors, and socio-economic characteristics.

The studies analyzed also showed that the impact of meteorological factors on mental health may vary depending on the study population. For example, studies in the general population were more likely to be associated with changes in emotional state, sleep disturbances, and higher rates of hospitalizations, while patient groups were more likely to report symptoms of anxiety and psychological distress (Bulanova et al., 2005; Mullins and White, 2019; Obradovich et al., 2017). This indicates that the impact of meteorological factors may depend not only on climatic conditions, but also on the health status of the subjects and individual sensitivity to environmental changes.

In summary, it can be stated that the impact of meteorological factors on mental health occurs through interrelated biological and physiological mechanisms that involve the processes of nervous system, hormones and sleep regulation. It should be noted that the findings presented in this review should be interpreted with caution, as this study is based on a narrative literature review rather than original empirical research. Therefore, the findings reflect general trends and relationships described in the scientific literature and cannot be interpreted as direct causal relationships.

Despite these limitations, the results of the reviewed studies provide valuable information about the possible relationship between meteorological factors and mental health. The data obtained may be useful as a theoretical basis for future empirical studies and contribute to a better understanding of the impact of meteorological factors on mental health in the context of climate change. Furthermore, these results may have implications for public health and environmental health, helping to identify relevant directions for further research.

## Conclusions

1. A review of the scientific literature has shown that meteorological factors, especially air temperature, are associated with changes in mental health indicators. The studies analyzed revealed that higher temperatures and heat waves are associated with higher emotional distress, increased hospitalizations, and suicide risk. It was found that a 1 °C increase in average temperature is associated with an approximately 0.7% increase in suicide rates in the United States and a 2.1% increase in suicide rates in Mexico.
2. The studies analyzed show that the effects of meteorological factors on mental health can be explained by biological and physiological mechanisms. Changes in temperature, mood, and other meteorological conditions can affect autonomic activity, cortisol secretion, serotonin regulation, and sleep processes. It was found that higher nighttime temperatures were associated with a decrease in sleep duration of approximately 44 hours per year, which may affect emotional state and mental temperature risk.
3. The studies analyzed also showed that the effects of meteorological factors may vary depending on the geographical region, climatic conditions, and study population, suggesting a possible interaction between environmental and individual factors.

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## METEOROLOGINIŲ VEIKSNIŲ POVEIKIS PSICHIKOS SVEIKATAI

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### Anotacija

Klimato kaita ir dažnėjantys ekstremalūs meteorologiniai reiškiniai didina susidomėjimą aplinkos veiksnių poveikiu sveikatai ypač psichikos. Tyrimu siekiama išanalizuoti meteorologinių veiksnių poveikį psichikos sveikatai. Atlikta naratyvinė mokslinės literatūros analizė, apžvelgiant straipsnius apie oro temperatūros, drėgmės ir ekstremalių oro reiškinių sąsajas su psichikos sveikatos rodikliais. Nustatyta, kad aukštesnė temperatūra ir karščio bangos siejamos su didesniu distresu, depresijos ir nerimo simptomais, dažnesnėmis hospitalizacijomis bei didesne savižudybių rizika. Nustatyta, kad oro drėgmė gali stiprinti karščio poveikį. Šie ryšiai aiškinami per biologinius ir fiziologinius mechanizmus. Temperatūros, atmosferos slėgio ir drėgmės pokyčiai sukelia organizmo stresinę reakciją ir autonominės nervų sistemos aktyvaciją. Dėl to kinta serotonino reguliacija, cirkadiniai ritmai bei streso hormonų, tokių kaip kortizolis, kiekis, o tai tiesiogiai veikia emocinę būseną, gali lemti depresijos, nerimo, nuotaikų svyravimų ir miego sutrikimų atsiradimą.

**Raktiniai žodžiai:** oro temperatūra, drėgmė, atmosferos slėgis, poveikis, psichikos sveikata.