

---

## METEOROLOGICAL DISASTERS – RISKS, CONSEQUENCES AND MEDICAL AID

**Rumyana Etova**

Department of Epidemiology and Disaster Medicine, Faculty of Public Health, Medical University of Plovdiv, Bulgaria, [rumyana.etova@mu-plovdiv.bg](mailto:rumyana.etova@mu-plovdiv.bg)

**Desislava Todorova**

Department of Social and Preventive Medicine and Disaster Medicine, Faculty of Public Health, Medical University – Sofia, Bulgaria [d.todorova@foz.mu-sofia.bg](mailto:d.todorova@foz.mu-sofia.bg)

**Elena Valkanova**

Department of Epidemiology and Disaster Medicine, Faculty of Public Health, Medical University of Plovdiv, Bulgaria, [elena.valkanova@mu-plovdiv.bg](mailto:elena.valkanova@mu-plovdiv.bg)

**Kiril Atliev**

Department of Epidemiology and Disaster Medicine, Faculty of Public Health, Medical University of Plovdiv, Bulgaria, [kiril.atliev@mu-plpdiv.bg](mailto:kiril.atliev@mu-plpdiv.bg)

**Abstract:** Frequent extreme weather and climate disasters threaten the normal functioning of the society. The purpose of this study is to emphasize meteorological disasters, and storms in particular, which threaten the life and health of the population, as well as the necessary measures to reduce the impact. Materials and methods: Documentary, descriptive and comparative methods were used to analyze scientific literature and press publications related to specific information on the subject. Results: The frequency of meteorological disasters shows an upward trend worldwide. Four specific cases of casualties of thunderstorms in 2022 and 2023 in Bulgaria are presented. The correct risk assessment, the preventive measures taken and adequate behavior during these disasters affect the outcome for those who are affected and injured. Conclusions: Meteorological disasters are a serious challenge for the economy, the institutions and the population in any country because they cause pronounced negative consequences for the agriculture and the economy, change the lifestyle by depriving the affected population of means of existence and increase the probability of irreversible and medical losses. The results of the analysis show that a comprehensive management approach to natural disasters is needed in accordance with the risks for the specific country, active steps to protect the population by carrying out preventive measures, timely actions by the institutions, as well as cooperation from the population. Conclusion: Forecasts for future meteorological disasters predict an increase in the number of thunderstorms with subsequent lightning strikes. We can talk about the current and ongoing climate vulnerability of the population as a result of global warming and changing climatic conditions. Studying the risk and prevention, occurrence and consequences, actions and rules, as well as providing timely and adequate first and first medical aid to storm casualties will reduce the negative consequences on the society and the economy. Continuous public awareness of upcoming climate changes, evolving weather conditions, maintaining constant readiness, and coordinated actions by institutions are necessary.

**Keywords:** meteorological disasters, risk, prevention, behaviour, medical aid

### 1. INTRODUCTION

Climate change and its impact on human health is an interdisciplinary issue of significant importance. Addressing this requires collective efforts from ministries, institutions, representatives of the health sector, the environmental sector, public authorities, the scientific community, the media, educational institutions, and workers in various sectors. However, the health sector in Bulgaria has not yet taken its leading role in implementing public health protection policies and suffers from a lack of information about best practices for adapting to the changing climate. (Spasova, Z.) Global warming is the cause of drastic climate changes worldwide. Climate change develops over a long period, and as a result, the consequences, especially in recent years, are increasingly being felt by people. These changes pose a serious problem for both individual and public health, and for the adaptation of the population to the constantly changing climate. (Austin, SE., Ford, JD., & Berrang-Ford L., et al.) As a result of climate catastrophes, the frequency and scale of meteorological disasters have significantly increased. (<https://www.dw.com/en/>) They are a serious challenge for the economy, institutions, and the population in every country. Meteorological disasters are starting to be considered a risk factor for people's lives and health, disrupting their normal way and rhythm of life. They lead not only to medical losses but also to human casualties. (Spasova, Z.) The aim of this study is to focus on meteorological disasters, specifically thunderstorms with subsequent lightning, which threaten and affect the lives and health of the population. The focus is on risk factors, the consequences of their impact, timely first aid and medical aid, and necessary preventive measures.

## 2. MATERIALS AND METHODS

Documentary, descriptive, and comparative methods were used to analyze scientific literature and press publications related to specific facts on the topic.

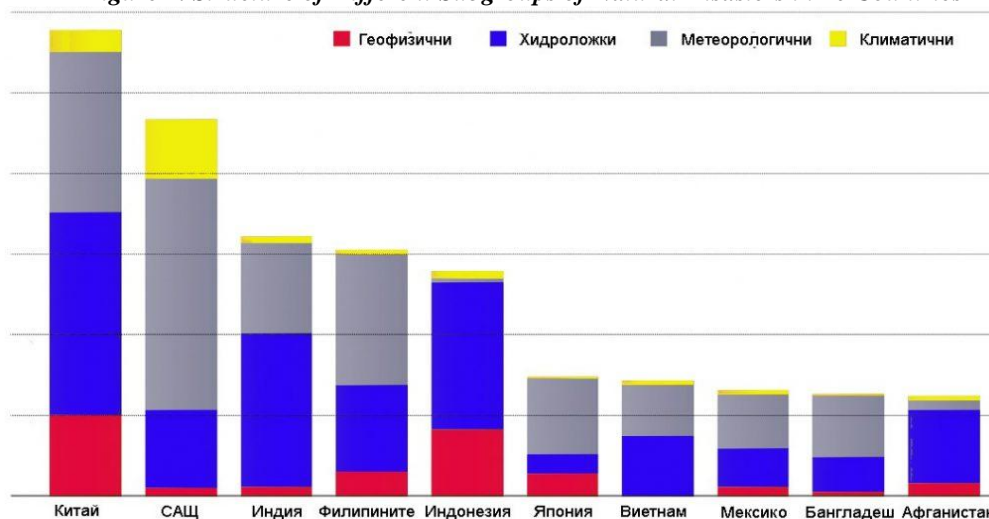
## 3. RESULTS AND DISCUSSION

A review of the scientific literature reveals that meteorological disasters are included in various classifications. Depending on the chosen criterion, there are classifications of disaster situations based on duration, the damaging factor, the damage caused, duration, number of casualties, the affected area, and others. In Bulgaria, a classification proposed by the World Health Organization has been adopted, which divides disaster situations into two main groups: disasters caused by human activities (anthropogenic disasters) and natural disasters (natural disasters that include meteorological, topological, tectonic, and cosmic disasters). (Kanev, K., Dimov, D., & Dragnev, V.)

According to other authors, the subgroups of natural disasters are divided into the following groups:

- Geophysical – earthquakes, landslides, volcanic activity;
- Meteorological – storms (extratropical storm, tropical storm, convective storm), extreme temperatures (cold wave, heat wave, severe winter conditions), fog;
- Climatic – droughts, melting glaciers and polar ice caps, wildfires;
- Hydrological – floods, landslides, impact of moving water masses;
- Biological – epidemics, animal incidents, insect invasions;
- Extraterrestrial – direct impact, indirect/mediated impact. (Knutson, T., Camargo, S.J., Chan, C. L.)

**Figure 1. Structure of Different Subgroups of Natural Disasters in 10 Countries**



Source: Centre for Research on the Epidemiology of Disasters (CRED) - <https://www.cred.be/>

The analysis of the structure of various natural disaster subgroups worldwide (Fig. 1) reveals that disasters directly related to atmospheric processes—storms, floods, extreme temperatures, droughts, wildfires, and landslides—outnumber geophysical disasters. Meteorological disasters show an upward trend globally, with an increasing number and scale. Frequent extreme meteorological and climatic disaster situations threaten normal societal functioning, causing severe economic repercussions, depriving affected populations of livelihoods, and leading to medical and irreversible losses.

Among meteorological disasters characteristic of the temperate continental region, storms, particularly during early and late summer, are of interest. In Bulgaria, thunderstorms with subsequent lightning strikes result in an average of 6 to 10 deaths annually. (Berberova, R.)

Storms are often accompanied by intense lightning activity. Lightning primarily forms in cumulonimbus clouds but can also occur during tornadoes, sandstorms, and volcanic eruptions. Lightning represents an electric discharge from the upper atmospheric layers to the Earth's surface, potentially reaching over a million volts with devastating force. Atmospheric electricity is discharged into the air, between clouds or from clouds to the ground. Typically, lightning forms in the lower part of storm clouds, where high temperatures (sometimes exceeding 180,000°C) cause a

blinding flash (lightning). This flash is followed by a deafening thunder caused by the rapid expansion of air due to high temperatures and subsequent contraction. (Glovnya, M., Blagoeva, E.)

Every country develops national strategies for disaster risk reduction. In Bulgaria, the framework for action during disaster situations is outlined for the period 2018–2030 and covers those disasters resulting from thunderstorms. (<https://www.strategy.bg>) Disaster situations necessitate numerous measures, including socio-economic aspects of population protection at both national and local levels. (Todorova, D.)

Lightning storms pose a significant risk to individuals outdoors, necessitating proper risk assessment, preventive actions, and appropriate behavior during thunderstorms, as well as suitable responses regarding the casualties. (Арустамов, Э., Косолапова.)

- Monitoring Weather Forecasts and plan outdoor activities only under favorable weather conditions.
- Risk Assessment for People:

Identify hazardous locations. Risk assessments show that human lives are endangered in the following areas: forest peripheries with tall trees, hilltops, sand dunes, high-voltage poles and masts, metal fences, and isolated trees with protruding branches.

- Preventive Measures:

Preventive measures include educating the population on proper behavior during the onset of a thunderstorm. The instructions for appropriate behavior may include several recommendations. For instance, when an individual or a group is caught in a thunderstorm, they should avoid running or lying down on the ground. It is also important to avoid staying at the edge of a forest or under isolated trees, standing between clusters of trees, or gathering in close proximity to others. Additionally, touching metal objects, using umbrellas or other protruding items, camping in open fields and on hills, and using outdoor toilets in buildings without lightning protection should be avoided for personal and collective safety.

- Behavior During a Thunderstorm:

People caught in such a disaster should take appropriate measures depending on where the thunderstorm overtakes them.

- For individuals in a building, it is advisable to close windows and balcony doors, move away from them, disconnect external antennas from television sets, unplug electrical appliances from the power network, and avoid using mobile phones during the storm.
- For those outdoors in nature, it is recommended to find a dry spot, remove any metal objects, crouch with legs close together, lower the head, and press the knees to the chest while holding the ankles with your hands. Running is discouraged due to the risk of "step voltage" in the event of a lightning strike.
- For individuals in a vehicle, temporarily halting the journey and stopping the vehicle in a safe location is advisable. Antennas should be retracted, doors and windows closed, and it is safest to remain inside the vehicle. If the vehicle is a motorcycle or bicycle, it is necessary to move a safe distance away from it.

(Костадинова, К., Фотева, Ф., & Янева, Н.)

- Response to Casualties:  
Without adequate risk assessment, preventive measures, and proper behavior, incidents can lead to medical and irreversible losses. Examples include:

Specific examples of the described impact on human health and life include four separate cases of individuals affected by thunderstorms in Bulgaria during 2022 and 2023:

1. **August 17, 2022:** Around 5 PM, a thunderstorm struck the town of Primorsko. A loud thunderclap and a subsequent lightning strike hit a young girl who was leaning against a solitary tree in a parking lot. The girl fell to the ground, experiencing severe breathing difficulties and a critical life-threatening condition. A staff member from a nearby hotel quickly intervened, performing CPR and artificial respiration for 20 minutes, saving the girl's life. The emergency medical team that arrived continued resuscitation efforts and immediately transported her to the nearest hospital. <https://btvnovinite.bg/bulgaria/malnija-udari-18-godishno-momiche-v-primorsko.html>; <https://www.24chasa.bg/bulgaria/article/12339266>
2. **September 27, 2022:** In the afternoon, a powerful storm with intense lightning activity struck the city of Sofia, producing hundreds of lightning strikes. Three people lost their lives in a park after being struck by lightning, while a fourth person was critically injured and transported to the hospital. All four had been sitting on a bench under a solitary tree. Three ambulances were dispatched, reaching the scene within nine minutes. The medical teams declared the death of three victims on-site and transported the fourth to the nearest medical facility. <https://dariknews.bg/regioni/sofiia/trima-zaginaha-porazeni-ot-mylniia-v-centyran-sofiia-2325544>; <https://btvnovinite.bg/bulgaria/chetirima-dushi-sa-udareni-ot-malnii-v-gradinkata-na-pirotska-v-sofiia.html>

3. **July 20, 2023:** During a sudden but intense thunderstorm in Burgas, on the central beach, an eight-year-old boy was struck by lightning and lost consciousness. His parents administered first aid, including artificial respiration and chest compressions, before driving him to a hospital. Emergency medical teams continued resuscitation efforts, successfully saving the boy's life. (<https://www.24chasa.bg/bulgaria/article/14961000>; <https://dariknews.bg/novini/bylgariia/mylniia-udari-dete-v-burgas-lekarite-se-boriat-za-zhivota-mu-2353911>)
4. **August 30, 2023:** In the late afternoon, during a training session at the "Dunav" stadium in Ruse, lightning struck during a thunderstorm, injuring two children. Emergency medical teams evacuated the children to hospitals. One of the children was in clinical death, with no heartbeat or breathing, and despite over an hour of resuscitation efforts, the outcome was not positive. The other child was in critical condition but responded to emergency measures. After months of treatment, the child was discharged in good overall health. (<https://btvnovinite.bg/bulgaria/malniija-e-udarila-tri-deca-na-stadion-v-ruse.html>; <https://www.mediapool.bg/izpisano-ot-bolnitsa-e-momcheto-porazeno-ot-malniya-v-ruse-news351268.html>)

Meteorological disasters can affect all age groups, with outdoor individuals being particularly vulnerable. This includes walkers, athletes, hikers, and children playing in parks and playgrounds. In the scientific literature, the vulnerability to the health effects of disaster situations is already being discussed. (Spasova, Z.)

The main injuries to people during meteorological disasters are closed and open wounds in various areas of the human body. Fractures, concussions, soft tissue injuries, lacerations and puncture wounds, bleeding, abrasions, bruises, sprains, burns, and other types of contusions are most common. As with all types of disaster situations, people must not give in to panic; they should remain calm, act appropriately, confidently, and sensibly. The help that needs to be provided before the arrival of medical teams should be in the form of self-help and mutual assistance. Therefore, to ensure personal safety and provide quick, adequate, and timely assistance, there is a need for theoretical and practical knowledge in providing first aid and medical assistance, which can be gained through courses and various training activities.

During a thunderstorm with a subsequent lightning strike, nearly all organs and systems of the body are affected. This is because several destructive factors are at play: electricity and the thermal effect of electricity.

As a result of the powerful electrical discharge in the atmosphere, a person can be struck by lightning, causing the cessation of breathing and the absence of a pulse. In such a situation, a quick risk assessment of the first aider must be made, and immediate cardiopulmonary resuscitation (CPR) should be started. The goal is to restore the suspended vital functions (heart activity, breathing, and the functions of the central nervous system). (<https://debatibg/>)

According to statistical data, approximately 24,000 people worldwide die each year from being struck by lightning during a thunderstorm. Nearly 10 times more—240,000 people—are struck by lightning. A large percentage of them survive, although with severe injuries. Many of the survivors suffer long-term consequences, such as permanent or temporary memory loss, weakened concentration, personality changes, and cognitive impairments.

Providing timely and adequate first aid and medical assistance to the injured saves lives, stabilizes their condition, and prevents the development of severe complications. (Shopov, D., Stoeva, T., & Atliev, K.) In such disaster situations, after assessing the medical situation and evaluating the condition of the injured, proper medical triage is crucial. It will determine the need for medical and preventive measures, as well as evacuation procedures, based on medical indications, and direct the injured to the appropriate medical facility for continued treatment. (CRED)

Meteorological disasters inevitably affect the psycho-emotional state of the victims. After such an event, stress and mental disorders significantly increase. These issues may manifest immediately (within the first few minutes after the disaster) or emerge hours, days, weeks, or even months and years later. This calls for early preventive, consultative, diagnostic, and psychotherapeutic assistance. (Boneva, V., Slavova, V., & Popzharieva, V.) (Dimitrov, P.) After a disaster, motivation for survival, individuals' attitude towards their own health, their awareness, and their improved competencies in prevention, protection measures, and preparedness to provide first aid are of particular importance. This applies not only to individuals in the population but also to the members of rescue and medical teams, who are also vulnerable in disasters. (Kreibich, H.) ([Petrova, G.](#)) (Алексиев P.)

Disaster situations, particularly meteorological disasters, pose a serious challenge to the economy, institutions, and populations of any country, as they cause significant negative impacts on agriculture and the economy, alter people's lifestyles by depriving affected populations of means of subsistence, and increase the likelihood of irreversible and medical losses.

Reliable protection of the life and health of the population during various types of disaster situations necessitates theoretical and practical training for young children, students, workers in various enterprises and sole proprietorships, as well as all vulnerable groups in the population on how to provide first aid and medical assistance.

Overcoming stress situations requires timely psychotherapeutic help, which is a crucial condition for the full recovery of the victims and their adaptation to a normal way of life and existence.

The findings of the analysis suggest that a comprehensive management approach to natural disasters is required, tailored to the risks specific to each country. Active measures for population protection through preventive actions and disaster response by institutions, as well as support from the population, are necessary.

The aim of these activities is to reduce existing risk factors in disaster situations, prevent the emergence of new ones, and enhance readiness and the ability to respond quickly—not only from institutional teams but also from the population itself. This includes preventive measures and timely and adequate first aid. All of this is crucial for the swift recovery after a disaster.

#### 4. CONCLUSION

Forecasts for future meteorological disasters predict an increase in the number of thunderstorms with subsequent lightning strikes. We can talk about the current and ongoing climate vulnerability of the population as a result of global warming and changing climatic conditions. Knowledge of meteorological disasters, risk factors, prevention, people's behavior, and the provision of timely first aid can ensure reliable protection and save human lives. Continuous public awareness of upcoming climate changes, evolving weather conditions, maintaining constant readiness, and coordinated actions by institutions are necessary. And, last but not least, educating the population on safety rules, behavior, actions, and medical assistance during meteorological disasters is essential.

#### REFERENCES

- Алексиев Р., Оцеляване в бедствени ситуации. София, ИДК НСА „Васил Левски” НСА-ПРЕС, 2004, 3-5 2  
Alexiev, R., (2004) Survival in disasters. Sofia. IDK NSA “Vasil Levski” NSA-PRES, 3-5.
- Арустамов, Э., Косолапова, Н., Прокопенко, Н., & Гуськов Г. (2014). Безопасность жизнедеятельности: Учебник для студ. сред. Б40 учеб. заведений: *Издательский центр «Академия»*, 176
- Austin, SE., Ford, JD., & Berrang-Ford L., et al, (2015). Public Health Adaptation to Climate Change in Canadian Jurisdictions, *Int. J.Res. Public Health*, 12, 624-627.
- Berberova, R., (2012). Natural disasters in Bulgaria – state and trends, Sofia, *New Bulgarian University*, 78-82
- Boneva, V., Slavova, V., & Popzaharieva, V. (2002). Disasters as a stress-factor. *Reports from Jubilee Scientific Conference*, Stara Zagora, 1, 282-286.
- CRED, Disasters Year in Review 2021, (2022). *Centre for Research on the Epidemiology of Disasters*, <https://www.cred.be/>.
- Dimitrov, P., (2012). Climate change and psychological health – concept frame and review of contemporary research. *Collection of reports from a symposium on medical geography with international participation "Traditions and modernity in medical geography and disaster medicine"*. Sofia. 25-26.10.2012
- Glovnya, M., Blagoeva, E. (1982). Physical geography of continents, Balkan Peninsula. Sofia, *Sofia Uni Kliment Ohridski*, 199-201. <https://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=1279>.
- Kanev, K., Dimov, D., & Dragnev, V. (2017). Textbook of Disaster Medicine. Sofia. *Uni izdatelstvo “Sv. Kliment Ohridski”*, 27-29.
- Knutson, T., Camargo, S.J., Chan, C. L., Emanuel, K., Ho, C. H., Kossin J., Mohapatra, M., Satoh, M., Sugi, K., & Walsh, L. (2020). Wu, Tropical cyclones and climate change assessment part II: projected response to anthropogenic warming, *Bull. Am. Meteorol. Soc.* 101 (3) E303–E322, <https://doi.org/10.1175/BAMS-D-18-0194.1> Spasova, Z., (2020). Policy on climate change adaptation. *WHO and NCPHA*. Sofia, 2. <https://www.dw.com/en/climate-change-triggers-disasters-threatens-millions-un/a-55243851>
- Kostadinova, K., Foteva, F., & Yaneva, N. (2004). Educational materials for reaction in disasters, accidents, catastrophes and fires. Sofia, *Spectar ben*, 42-43.
- Kreibich, H., Hudson, P., & Merz, B. (2021). Knowing what to do substantially improves the effectiveness of flood early warning. *Bulletin of the American Meteorological Society*, 102(7), E1450– E1463. <https://doi.org/10.1175/BAMS-D-20-0262.1>
- Микрюков, ВЮ., (2007). Безопасность жизнедеятельности: Учебник. Ростов н/Д. *Феникс*, 2007, 557. <https://debati.bg/udar-ot-malnia-smart-i-otselyavane-video/>
- Petrova, G., Semerdjievax, M., & Bakova, D., et al. (2013). [The health project – a means of increasing competences in the field of public health. \*Health Economics and Management\*. 2013.3\(49\):35-39.](https://doi.org/10.1175/BAMS-D-18-0194.1)
- Shopov, D., Stoeva, T., & Atliev, K., (2021). Reality in the primary medical care, *General medicine*, 23(4), 19–25.
- Spasova, Z., (2014). Climate change – threat for human health. *MH and NCPHA*. 2014, 4-14.
- Spasova, Z., (2007). Climate change – a threat to children’s health. *Pediatrics*, 53, 2013, 49-54.

Todorova, D., (2012). Actions for Protection on National and Local Level. Social-Economical aspects of Disasters and Disaster Relief, Sofia, *Copy Partner Center*, 36.

<https://btvnovinite.bg/bulgaria/malnija-udari-18-godishno-momiche-v-primorsko.html>

<https://www.24chasa.bg/bulgaria/article/12339266>

<https://dariknews.bg/regioni/sofiia/trima-zaginaha-porazeni-ot-mylniia-v-centyra-na-sofiia-2325544>

<https://btvnovinite.bg/bulgaria/chetirima-dushi-sa-udareni-ot-malnii-v-gradinkata-na-pirotska-v-sofiia.html>

<https://www.24chasa.bg/bulgaria/article/14961000>

<https://dariknews.bg/novini/bylgariia/mylniia-udari-dete-v-burgas-lekarite-se-boriat-za-zhivota-mu-2353911>

<https://btvnovinite.bg/bulgaria/malnija-e-udarila-tri-deca-na-stadion-v-ruse.html>

<https://www.mediapool.bg/izpisano-ot-bolnitsa-e-momcheto-porazeno-ot-malniya-v-ruse-news351268.html>