REVIEW

BUILDING RESILIENCE TO COPE WITH HEAT WAVES AND EXTREME WEATHER EVENTS IN THE REPUBLIC OF NORTH MACEDONIA

Mihail Kochubovski[1]

[1] *Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, North Macedonia*

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***Correspondence:** Mihail Kochubovski, Faculty of Medicine, Ss. Cyril and Methodius University in Skopje; Republic of North Macedonia

E-mail: kocubov58@yahoo.com

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Abstract

High ambient temperatures have a significant impact on society and population health, including a rise in morbidity and mortality. Episodes of heat lasting for several days are often referred to as heat waves and can be associated with tens of thousands of premature deaths. In the Republic of North Macedonia, the most striking weather anomaly was in 2007, when the national government declared a nationwide heat-wave emergency. The content of this inspirational example outlines a wide range of coordinated actions at community and system levels to adapt, anticipate and manage the many problems caused by heat waves. The example shows the need of intersectional action to build adaptive, absorptive, anticipatory and transformative resilience capacity in both communities and institutions in order to effectively fight against the harmful health effects of heat waves. There were several heat waves in the country during 2007-2023 and public health activities to prevent and minimize adverse health effects.

ПРЕГЛЕД НА ЛИТЕРАТУРА

ГРАДЕЊЕ НА ОТПОРНОСТ ЗА СПРАВУВАЊЕ СО ТОПЛОТНИ БРАНОВИ И ЕКСТРЕМНИ ВРЕМЕНСКИ НАСТАНИ ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

Михаил Кочубовски[1]

[1] *Медицински факултет, Универзитет „Св. Кирил и Методиј“ во Скопје, Република Северна Македонија*

Цитирање: Кочубовски М. Градење на отпорност за справување со топлотни бранови и екстремни временски настани во Република Северна Македонија. Арх Ј Здравје 2024;16 (2) doi.org/10.3889/aph.2024.6139

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***Кореспонденција:** Михаил Кочубовски, Медицински факултет, Универзитет „Св. Кирил и Методиј“ во Скопје, Република Северна Македонија.E-mail: kocubov58@yahoo.com

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Извадок

Високите амбиентални температури имаат значително влијание врз здравјето на населението и општеството, вклучително и пораст на морбидитетот и морталитетот. Епизодите на топлина кои траат неколку дена често се нарекуваат топлотни бранови и може да се поврзат со десетици илјади предвремени смртни случаи. Во Република Северна Македонија, највпечатлива временска аномалија имаше во 2007 година, кога националната влада прогласи вонредна состојба заради топлотен бран низ целата земја. Содржината на овој инспиративен пример прикажува широк опсег на координирани дејства на нивоа на заедницата и системот за да се приспособат, предвидат и управуваат со многуте проблеми предизвикани од топлотните бранови. Овој пример ја покажува потребата од интерсекторски активности за да се изгради капацитет за отпорност и во заедниците и во институциите со цел ефикасно да се спротивстави на штетните здравствени ефекти од топлотните бранови. Имаше неколку топлотни бранови во земјата од 2007 до 2023 година и јавноздравствени активности за спречување и минимизирање на негативните здравствени ефекти.

Introduction

During the summer of 2007, daily temperatures reached 43°C and caused more than 1000 excess deaths at national level (compared to the averages of 1994–2008). In Skopje, the capital city with around 600 000 inhabitants, temperatures in July 2007 were 3.4°C above the monthly average, and deaths were 16.5% higher than the average between 1994 and 2008. The direct health effects of heat waves could become a significant problem, especially with more than 60% of the population living in cities while urbanization is increasing.

The heat cut-off point for the maximum temperature for Skopje was 30.8°C. Under heat-wave conditions, an increase of 1°C above the heat cut-off point for Skopje increased the total mortality by 4.8%. The increased mortality during heat waves is higher among older people with chronic diseases, and cardiovascular and respiratory diseases[1]. Compared to the baseline period (1986–2005), heat-related mortality in Skopje is projected to more than double in 2026–2045, and more than quadruple in 2081–2100[2].

It has been estimated that the expected impact in the country will be much larger than if temperatures remain at the observed historical levels. During the period 2071–2099, an overall excess of 305 and 871 attributable deaths per year is expected under the Representative Concentration Pathway (RCP) 4.5 and RCP 8.5 scenarios, respectively, in addition to 14 attributable deaths estimated under the historical scenario[3]. Under anticipated future warming conditions, the length, frequency and intensity of heat waves are expected to increase. Taking into consideration that the national population is aging, an increase in heat-attributable deaths is a serious risk. In order to avoid such negative scenarios, effective adaptation measures must be taken. Policies and plans for heat mitigation and adaptation are urgently needed in European countries in order to prevent the expected increase of heat-related deaths in the coming decades[4].

Action

A National heat–health action plan was developed within the country's Strategy to adapt the health sector to prevent health consequences associated with extreme heat due to climate change[5,6]. Its goal is to reduce morbidity connected with heat waves by issuing heat and health warnings, encouraging planning in the relevant sectors, prioritizing health in all policies, raising public and health sector workers' awareness and mobilizing resources for managing heat effects.

A national framework was established to build adaptive capacity for climate change resilience in the public health community to better address the effects of climate change and to oversee activities. A national, multisectoral steering committee and a technical working group were established, and they defined the scope of the national adaptation plan, methods, peer review process and process for defining priorities using a WHO comprehensive framework for developing national climate change health adaptation strategies[7]. The WHO framework incorporates an assessment of climate change im-

pacts, a vulnerability assessment, the modelling of projected health impacts, an evidence-based evaluation of intervention options, a strategy for implementing interventions and systematic evaluation of all activities in an iterative manner.

A team from the Institute of Public Health, supervised by the national steering committee, conducted a scoping exercise to identify readily available information and data on the heat-associated health exposures and risks to population health, and vulnerability and impact assessments. A variety of qualitative and quantitative methodologies were used in the assessment: literature reviews, interviews, focus groups, time series and regression analysis, damage and adaptation cost estimation, and scenario-based assessment.

Other areas addressed by the national health adaptation strategy include: adapting the health care infrastructure (hospitals, nursing homes) to be more resilient to the effects of heat, fires and floods; developing local "Safety Hospital" plans to cope with disasters; and increasing awareness of how people can adapt to changes in climate. Developing the strategy underscored the need of greater emphasis on climate change and its impacts; the need governments to focus on this problem; and measures individuals can take to mitigate the effects of climate change on their health.

In order to increase the resilience of the health sector to cope with health impacts of climate change and to strengthen national capacity for assessing these impacts, the following activities took place:

- the training of more than 300 health and environmental professionals, journalists and other profiles on health effects of climate change, with an emphasis on heat waves;
- an assessment of health effects of climate change in the country;
- a study that examined the impact of heat waves on morbidity in summer months in the country in the period 1994–2009;
- a study on the correlation between the occurrence of Salmonella infection and average weekly temperature distribution in the period 1996–2009;
- a study on the presence of the vector *Aedes albopictus* in the country, published in 2011;
- a study on the impact of climate change on pollen micro flora related to the respiratory allergies among the adult population in Skopje, published in 2011; and
- a publication on health effects of climate change in the Republic of Macedonia, available in English and local languages.

Climate change mitigation efforts by the health sector include implementation of activities on energy efficiency and promotion of the use of renewable energy sources in hospitals and health institutions. Such measures were initiated by the Ministry of Health with the WHO support in 2009 in two pilot municipal hospitals in Gostivar and Shtip. Furthermore, the Government adopted measures for refurbishment of all hospital facilities at secondary and tertiary levels in the country, including energy efficiency measures. These measures help to reduce greenhouse gas emissions at mu-

nicipal level and raise awareness of health managers and staff on the effects of climate change. Hospital staff training regarding energy saving and environmental protection strategies is to be done.

One of the main proposed solutions was the implementation of a structured system for timely heat-wave announcements (alert system), particularly during the period from 1 May to 30 September (5). This includes: the set-up of a responsible body, a 24–48 hour early heat warning, specific thresholds for action, and priorities for vulnerable populations, workers' health and communication. The alert system is part of the broader approach designed by the national heat–health action plan. Further elements are:

- coordination body for plan implementation;
- communication plan to inform the public and the health and social sectors about protection during heat waves, along with recommendations given by the Ministry of Health addressed to health workers, general population and at-risk groups;
- recommendations and (medium-term and short-term) strategies for reducing exposure to heat inside health and social institutions, and special protection plans for vulnerable population groups; and
- long-term planning for preparedness of the health and social care systems, including: planning and training of personnel, appropriate health protection, creating green areas, improving the energy efficiency of hospitals and reducing the emission of greenhouse gases.

Regarding implementation, monitoring and evaluation of the plan, certain activities have taken place. Firstly, a heat–health watch system operates during the summer months, with advice from the National Institute of Public Health and the Ministry of Health, with four levels of response and appropriate advice. The heat–health action plan provides a summary of key measures to be undertaken by the responsible sectors and institutions. These measures aim to decrease morbidity connected with heat waves by issuing heat and health warnings from the Hydrometeorological Institute to encourage planning in the relevant sectors and to raise public and health worker awareness, as well as to mobilize the resources for managing the heat effects. The action plan consists of a set of previously agreed upon activities and preparations to be carried out by the health sector and institutions, in order to raise awareness and reduce heat risks. Furthermore, the plan gives guidance for the responsibilities of the institutions and individuals in terms of taking measures after a heat-wave announcement.

Secondly, information leaflets for protection against heat waves, aimed at the general population, managers in health and social institutions, general practitioners and workers were prepared and printed. The Red Cross, regional public health institutes and their local branches, municipalities and the Labour Inspectorate distributed the information.

Thirdly, an application for Android mobile phones providing heat and

health warnings and related recommendations was also developed. The Government endorsed the heat–health action plan in February 2012, and it is now fully in effect, following the successful piloting of specific heat-protection actions in the summers of 2010 and 2011 7. Representatives of the Macedonian Red Cross distribute information during the heatwave in Skopje.

Impact

While there have been specific project benefits, such as increasing the awareness among health professionals with regard to health impacts of climate change, and the development of the heat–health action plan and the cold health action plan, the broader benefit has been in the increased engagement of key stakeholders and policy-makers with this agenda[8]. Before the process was initiated, climate change and health topics were largely marginalized, with activities happening in silos. Creating such cooperative and supportive environments is crucial for strengthening resilience as recommended by Health 2020 and its priority area four[9].

In the current implementation period, this collaborative approach has proven to work well.

The heat–health action plan was evaluated in 2015, and 100% of survey participants from all implementing institutions (N=38) agreed that proposed activities and approaches were appropriate. At the time of the evaluation, more than half of the proposed activities were implemented (52%); lack of staff and funding, as well as staff indifference, accounted for the other half. Of the respondents, 83% called for more field visits, targeted and tailored action for groups and capacity building at local level: general practitioners, social care workers, employers, inspectors etc. Most respondents (96%) would like the heat–health action plan to continue but with more funding from the central budget. Many of the successes in the country's climate

change health assessment have already begun to have an impact. Nevertheless, building adaptive and anticipatory resilience capacity remains an ongoing concern. Throughout the process, a number of tools were utilized which allowed practitioners to organize information on the hazards and at-risk populations in order to prioritize responses. These successes provide an ongoing foundation for future collaboration and activity. In 2020, under the EU Project SCORCH, another evaluation of the heat–health action plan was made, and it was concluded that organizational structure, warning system, communication plan, measures for emergency management and acre for vulnerable groups were very well developed and implemented.

The study in Skopje calculated the projected average annual mortality attributable to heat in the absence of adaptation or acclimatization during specific time windows, and evaluated the contribution of each source of uncertainty on the final impact[2]. Improvements in infrastructures and health care services together with heat-adaptation measures have beneficial effects on reducing the impact of heat on mortality. It can be accomplished by reducing heatwave-related morbidity and mortal-

ity through heat–health warnings, especially for the most vulnerable groups: older people, infants and children up to five years old, the chronically ill, people who are overweight, people who work outdoors, and those whose social factors (nationality, profession, educational level etc.) make them particularly vulnerable.

In order to strengthen preparedness for crisis situations and climate change-related emergencies, a simulation exercise took place on 22 May 2013, in the Strumica Region in the country. The key stakeholders were the Ministry of Health, Strumica General Hospital (an important regional hospital centre), emergency medical services, the Crisis Management Centre, the Red Cross, fire rescue units, the Ministry of the Interior, the Ministry of Defence and WHO. Prior to the simulation exercise, preparatory meetings were held to establish the parameters of the exercise such as the number of expected casualties, trigger indicators for activating the emergency response plan, triage and patient traffic flow, as well as the responsibilities of hospital and emergency medical staff. The simulation allowed the authorities to test general preparedness and also the implementation of the national heat–health action plan [10].

Moreover, a partial reduction in health impacts is an expected benefit as a result of adaptation measures implemented (in this case a heat–health action plan). Investment costs such as infrastructure, equipment and training are important for effective health preparedness and response. In the country, the main one-off investment is made by the Ministry of Health, and social infrastructure and lesser investments are made by local governments. These costs include energy efficiency measures, air-conditioning and water fountains in hospitals and nursing homes, and communication and awareness-raising for medical staff and the general public. The total cost of health damage attributed to climate change and heat for the selected outcomes in the country was estimated at 170 million local currency units (LCU) per year. A cost–benefit analysis compared the damage costs of the increase in disease cases and of deaths not averted with the costs of adaptation and its expected reduction of negative health effects. The adaptation cost is estimated to be 12 million LCU. When compared with the total damage costs (170 million LCU per year), the adaptation costs appear to be relatively small[11].

Due to climate change, an extreme weather event as a freakishly violent rainstorm that Macedonia's top weather official called a "water bomb" ravaged Skopje, Republic of North Macedonia on 6th of August 2016, collapsing streets, inundating vehicles and drowning trapped motorists and homeowners, most of them caught by surprise.

Torrential rainfall caused flash flood 33/l/m^2 in the first 30 minutes, and /93 l/m^2 in the following 2 hours. Flood has caused 22 deaths in Skopje's region. The Ministry of Health, the Institute of Public Health and all other health institutions (primary, secondary and tertiary health care) from the first moment were providing proper health care to endangered people in the flooded areas. They were also providing environmental

health surveys and epidemiological surveillance on the terrain, delivering recommendations and conducting monitoring of drinking water quality, disinfection, desinsection and deratization of properties and goods, as well as on the contaminated areas. Epidemiological situation was stable. According to the proposal by the Governance Committee for coordination and management of crisis, emergency state was declared by the Government with duration of 15 days (07-22.08.2016). First responders on the ground were units for first response (Ministry of Interior, fire brigade and emergency medical services-EMS), and due to the meteorological situation, human loses and damaged areas, the President of the Republic of Macedonia activated the armed forces to take response actions. Protection and Rescue Directorate activated the reserve forces. The Ministry of Health, Red Cross of the Republic of Macedonia and all relevant governmental institutions and self-governmental institutions with their public enterprises started with their filed activities for preparation and distribution of food and safe drinking water (bottled and water tanks), clothes, hygienic means, etc.

Surface Urban Heat Island (SUHI) is a documented urbanization-driven phenomenon, causing higher temperatures in cities than in surrounding rural areas. Global warming, rapid urbanization, and UHI amplify thermal stress and endanger public health. A cross-sectional study was conducted, in Skopje, Republic of North Macedonia from 22.07 to 28.07. 2022. Monitoring temperatures thrice daily, we compared locations with and without tree coverage. Utilizing Landsat-8 data on July 22, 2022, we extracted SUHI patterns. Four of nine locations studied displayed (UHI) effects. The largest temperature difference, 7.9°C, occurred between a treeless one-way street and City Park. On average, temperature differences between the hottest and coolest spots were 6.8°C. All tree-covered areas showed lower ambient temperatures. Green spaces, like parks and tree-lined gardens, play a crucial role in mitigating thermal stress and counteracting UHI's adverse impact on public health. This study emphasized the importance of urban planning and incorporating green infrastructure to combat UHI's detrimental effects amidst climate change and urbanization challenges. Policies promoting and preserving green spaces are essential for creating climate-resilient and sustainable cities prioritizing inhabitants' well-being [12].

Lessons learnt

In order to ensure effective implementation of planned actions and impact, organizational arrangements are crucial. The Ministry of Health has overall responsibility for implementing the heat–health action plan. The Climate Change and Health Commission was established within the Ministry of Health in June 2009. The Commission has participated in the preparation of the national heat–health action plan, in the execution, surveillance and evaluation of the plan. The Commission is responsible for coordinating the involvement of institutions during the implementation of the plan's activities, as well as for promoting multisectoral cooperation. One rec-

ommendation is that, when necessary, people from other relevant institutions should be included in the Commission. The following institutions and organization are included: the Institute of Public Health and Public Health Centres, the Institute of Occupational Medicine (WHO Collaborating Centre for Occupational Health), the Crisis Management Centre, the Hydrometeorological Institute, the Directorate for Protection and Rescue, departments that improve the living environment within municipalities (in the first phase, active participation of the city of Skopje), the Ministry of Transport and Communications, the Ministry of Labour and Social Policy, the Ministry of Education and Science, the Macedonian Red Cross, the media and the non-governmental sector. Community awareness and engagement are very important. Intensifying the dissemination of information through workshops, roundtables, preparation of brochures, leaflets, campaigns, the use of electronic and print media, social networks, etc., should serve in increasing the community awareness of the problem of heat waves, other extreme weather events and climate change.

Using preventive interventions and policies to reduce the health risks and the potential effects of climate change and extreme weather events on population health requires further capacity building in the health sector. This is especially relevant in the field of environmental health.

Capacity should be strengthened in order to better provide, recognize, assess and control the changes in the environment and the related hazards. Furthermore, increased focus on modelling and adaptive management and effective use of local community resources and assets is needed to strengthen the resilience of the community as part of building an integrated, efficient and effective public health approach.

Professors at the Faculty of Medicine, Ss. Cyril and Methodius University in Skopje employed at Institute of Public Health of the Republic of North Macedonia have developed a Chapter on Climate and Health in the Curricula of the Faculty of Medicine in Skopje for medical students and published a handbook entitled "Hygiene and Environmental health" in 2008[13].

References

1. Kendrovski V, Menne B, Spasenovska M. The public health impacts of climate change in the former Yugoslav Republic of Macedonia. Int J Environ Res Public Health. 2014;11(6):5975–88. doi:10.3390/ijerph110605975.
2. Martinez GS, Baccini M, De Ridder K, Hooyberghs H, Lefebvre W, Kendrovski V et al. Projected heat-related mortality under climate change in the metropolitan area of Skopje. BMC Public Health. 2016;16:1–12. doi:10.1186/s12889-016-3077-y.
3. Kendrovski V, Baccini M, Martinez GS, Wolf T, Paunovic E, Menne B. Quantifying Projected Heat Mortality Impacts under 21st-Century Warming Conditions for Selected European Countries. Int J Environ Res Public Health. 2017 Jul;14(7):729. doi:10.3390/ijerph14070729.

4. Bittner MI, Matthies EF, Dalbokova D, Menne B. Are European countries prepared for the next big heat-wave? Eur J Public Health. 2014 Aug; 24(4):615–619. doi:10.1093/eurpub/ckt121.

5. Kendrovski V, Spasenovska M. Action Plan for Preventing the Effects of the Heat Waves on the Population in the Republic of Macedonia. Skopje: Ministry of Health of the former YugoslavRepublic of Macedonia; 2012:3–28.

6. Kendrovski V, Spasenovska M. Climate change – health adaption strategy and action plan of theformer Yugoslav Republic of Macedonia. Copenhagen: WHO Regional Office for Europe; 2013:4–35 (http://www.euro.who.int/__data/assets/pdf_file/0018/144171/e95094.pdf).

7. Protecting health from climate change: a seven-country initiative. Copenhagen: WHO Regional Office for Europe; 2013:4–10 (http://www.euro.who.int/__data/assets/pdf_file/0019/215524/PROTECTING-HEALTH-FROM-CLIMATE-CHANGE-A-seven-country-initiative.pdf?ua=1).

8. Matthies F, Bickler G, Marin NC, Hales S. Heat–health action plans. Guidance. Copenhagen: WHO Regional Office for Europe; 2008 (http://www.euro.who.int/__data/assets/pdf_file/0006/95919/E91347.pdf?ua=1).

9. Health 2020. A European policy framework and strategy for the 21st century. Copenhagen: WHO Regional Office for Europe; 2013 (http://www.euro.who.int/en/publications/policy-documents/health-2020.-a-european-policy-framework-and-strategy-for-the-21st-century-2013).

10. Ready to take the heat in the former Yugoslav Republic of Macedonia. In: WHO/Europe [website]. Copenhagen: WHO Regional Office for Europe; 2013 (http://www.euro.who.int/en/health-topics/emergencies/disaster-preparedness-and-response/news/news/2013/06/ready-to-take-the-heat-in-the-former-yugoslav-republic-of-macedonia).

11. Climate change and health: a tool to estimate health and adaptation costs. Copenhagen: WHO Regional Office for Europe; 2013 (http://www.euro.who.int/__data/assets/pdf_file/0018/190404/WHO_Content_Climate_change_health_DruckIII.pdf?ua=1).

12. Bukovetz J, Kochubovski, Kaplan G. Urban Heat Island and Green Spaces in the City of Skopje: An Environmental Health Approach Combined with Remote Sensing data. Research Square. 2023: 1-23. DOI: https://doi.org/10.21203/rs.3.rs-3193084/v1.

13. Gjorgjev D, Kochubovski M, Kendrovski V, Ristovska G. Hygiene and Environmental Health. Handbook: Medical Faculty-Skopje. CIP 613 (075.8), ISBN 978-9989-2594-5-6, National and University library “Ss Kliment Ohridski”-Skopje; 2008: 1-484.