

Open Space & Recreation Pathway **MMC Heat Preparedness Plan Heat Health Research Brief**

Authors: Jeanette Pantoja, Tanaya Tonpay

Social determinants of health are the conditions in which people live that affect a wide range of health risks and outcomes. Our social context, economic situation, and built environment can buffer climate impacts by providing us a means to cope or adapt. They can also amplify climate impacts, especially among communities that have been subjected to structural racism and other inequities. MAPC identified six social determinant pathways through which people experience climate-driven extreme heat impacts. For each pathway, MAPC conducted a brief literature review and summarized the findings into a short memo.

Key Insights

- Green spaces promote health through a variety of mechanisms, including increased levels of physical activity, decreased levels of stress, increased social interaction and cohesion, crime reduction, and improved environmental services of air quality and shade provision.
- Outdoor temperature has a significant impact on travel behavior, including but not limited to outdoor recreation and commuting. Street orientation and vegetation are landscape design strategies that can offer relief to the barriers imposed by extreme heat in urban centers. Heat also influences how people use other recreational spaces, including parks and playgrounds.
- Potential heat and open space and recreation associated health impacts include increased risks for heat-related illnesses, exposure to allergens and insect- and water-borne disease vectors, and increased risk of drowning, especially among children.
- Historically low public and private investment in neighborhoods primarily home to Black, Indigenous, and People of Color (BIPOC) has resulted in disproportionately fewer green spaces and higher rates of associated adverse health outcomes in these communities.
- Disproportionate drowning deaths among BIPOC individuals is at least partly due to a legacy of institutional and sometimes violent exclusion of these communities from recreational spaces. Disinvestment in recreational spaces and user fees risk inadvertently perpetuating these inequities.

Recommendations

- Expand the breadth of research linking thermal comfort and health to urban greenspace among the homeless population.
- Continue to push for urban forestry master planning and planning instruments that improve equitable access to urban greenspace and recreational space.
- Design open and recreational space with the needs of senior residents in mind.

- Incorporate research linking gentrification trends and proximity into urban greenspace and open space into master planning.

Research Summary

Heat-related environmental health exposures include high heat days and heat waves, increased prevalence and expanded range of insect vectors, diminished air and water quality, and longer pollen season. Potential heat health impacts include diminished quality of life, heat-related illnesses, worsening of chronic and mental health conditions, and increased risk of drowning and water- and vector-borne illnesses. These risks are amplified in dense urban areas due to a phenomenon known as the Urban Heat Island (UHI) effect. UHI refers to the relatively higher temperatures in urban cores caused by a high concentration of dry, absorptive surfaces. Open and green spaces provide a cooling effect to UHIs and to communities outside the urban core through shade and evapotranspiration.¹ While the benefits of urban green space are significant, it is important to note that they are inequitably distributed across different demographics, a topic that will be explored further later in this brief.

Connections Between Health and Urban Green Space

Green (vegetated) and open spaces provide many individual and community-wide health benefits. “Greenspace (sometimes ‘green space’) is an umbrella term used to describe either maintained or unmaintained environmental areas, which can include nature reserves, wilderness environments and urban parks. Often, particularly in urban contexts, greenspaces are purposefully designated for their recreational or aesthetic merits,” which are associated with physical, mental, and ecological health.² In 2013, MAPC conducted a Health Impact Assessment (HIA) for the Healthy Neighborhood Equity Fund, which included a literature review of the health impacts of green spaces. A 2020 update of the literature review reported that green spaces promote health through a variety of mechanisms, including increased levels of physical activity, decreased levels of stress, increased social interaction and cohesion, crime reduction, and improved environmental services of air quality and shade provision (MAPC, 2020). The 2020 Update to the HIA provides more explanation for each mechanism, but two are further explained below.

Literature findings on the health impacts of green space and reduced stress levels were generally positive. A 2017 article published by the Royal College of Psychiatrists suggests that proximity to and use of nearby greenspaces helps to buffer the impacts of stress.² The same analysis found that “people who use the natural environment for physical activity at least once per week have about half the risk of poor mental health compared with those who do not do so; and each extra

¹ Hiemstra J.A., Saaroni H., Amorim J.H. (2017) The Urban Heat Island: Thermal Comfort and the Role of Urban Greening. In: Pearlmutter D. et al. (eds) *The Urban Forest. Future City*, vol 7. Springer, Cham. https://doi.org/10.1007/978-3-319-50280-9_2

² Barton, J., & Rogerson, M. (2017, November 1). The importance of greenspace for mental health. *BJPsych international*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5663018/>.

weekly use of the natural environment for physical activity reduces the risk of poor mental health by a further 6%”.² Additional mental health benefits of green spaces include reduced anxiety levels and improved restorative effects, self-esteem, mood, ADHD, behaviors, and attention spans.³

Most studies found consistent relationships between greenness (density of vegetation) or green space use and increased levels of physical activity. This was particularly true for green space in the form of parks with activity and community programming, trails, greened streetscapes, urban gardens, playgrounds, and temporary road closures.³ Green space visitation particularly promotes physical activity among children and adolescents because these populations typically use active transport such as walking or biking to get to green spaces in addition to physical activity undertaken while there.⁴

Literature cited in the 2020 HIA update consistently indicated positive relationships between green space and reduced urban heat.³ Schinasi et al. further tracked these effects using a meta-analysis and found urban greenness to be modestly associated with decreased risks for heat-related illnesses and deaths.

Heat Impacts on Open Space Usage and Recreational Behavior

Outdoor temperature has a significant impact on travel behavior, including but not limited to outdoor recreation and commuting. Street orientation and vegetation are landscape design strategies that can offer relief to the barriers imposed by extreme heat in urban centers. Research shows that urban trees provide many health benefits such as improving microclimatic conditions for residents and decreasing local air temperature, which enhances pedestrian experience and reduces potential adverse heat-related health impact.⁵ In contrast to absorptive surfaces such as concrete, vegetation in green space helps to reduce heat through the process of evapotranspiration. The City of Cambridge’s Urban Forestry Plan offers an example of what optimizing space to maximize canopy coverage can look like. Cambridge aims to improve the pedestrian experience through increased canopy coverage to create cool corridors which subsequently encourages residents to take advantage of cooler conditions and walk or bike where heat may have otherwise been a deterrent.

Beyond travel and commuting behavior, heat has varying impacts on the use of green spaces and other types of recreational spaces. A 2019 study revealed that many users maintain the same park visitation frequency during heat waves as during non-heat waves, but adapt how they use these spaces, such as by visiting during later hours of the day to avoid peak temperatures. The same

³ Schinasi LH, Cole HVS, Hirsch JA, Hamra GB, Gullon P, Bayer F, Melly SJ, Neckerman KM, Clougherty JE, Lovasi GS. Associations between Greenspace and Gentrification-Related Sociodemographic and Housing Cost Changes in Major Metropolitan Areas across the United States. *Int J Environ Res Public Health*. 2021 Mar 23;18(6):3315. doi: 10.3390/ijerph18063315. PMID: 33806987; PMCID: PMC8005168.

⁴ Vanos, J.K., Middel, A., McKercher, G.R., Kuras, E.R., Ruddell, B.L. (2016). Hot playgrounds and children’s health: A multiscale analysis of surface temperatures in Arizona, USA. *Landscape and Urban Planning*. 146, 29-49.

⁵ Sanusi, R., Johnstone, D., May, P., & Livesley, S. J. (2016). Street Orientation and Side of the Street Greatly Influence the Microclimatic Benefits Street Trees Can Provide in Summer. *Journal of Environmental Quality*, 45(1), 167–174. <https://doi.org/10.2134/jeq2015.01.0039>

study showed that “[an] old-grown, tree-rich park was used significantly more frequently for experiencing nature, while the newer, less tree-rich park developed on a former railway-brownfield site was used more often for socializing and having BBQs and picnics”. Heat-related risks at playgrounds have not been researched as extensively as other types of playground health risks, such as injuries from play, but high temperatures can affect the number of visitors, duration of visits, and activity levels of play.⁶ Many playgrounds lack adequate shade, either structural or vegetated, and playgrounds with artificial materials and little shade have some of the highest surface temperatures within urban areas.

Open Space and Recreation Related Heat Health Impacts

Heat-Illnesses

Outdoor heat exposure “varies significantly by city, demography, and activity” according to a 2018 study of urban outdoor heat exposure across fifty US metro areas. This study found that individuals in cities with the hottest temperatures do not necessarily experience the greatest exposures, likely due to behavior change and acclimatization, and that older adults and low-income individuals experience the greatest outdoor heat exposure. Traveling, lawn and garden care, and recreation are among the most common activities contributing to outdoor heat exposure.⁷ These findings resonate with other research and engagement findings on heat health risks among landscaping workers, active transportation users, and athletes. Heat-illness is a leading cause of injury and death among high school and college athletes but affects other demographics engaging in outdoor recreational activities. Among outdoor recreation participants, males, and youth ages 15-19 experience the greatest rates of heat-related hospitalization.⁸

Insect- and Water-Borne Illnesses

Despite the many benefits of green spaces, they can also increase exposure to vector- and water-borne illnesses. A 2014-2016 study in Antwerp, Belgium on the relationship between presence of the *Borrelia* pathogen (Lyme disease) in ticks and distance to the nearest green space revealed that density of infected ticks increased with connectivity to greenspace.⁹ Lyme disease is one of several arboviruses that are spread to people by the bite of infected insects. Other rare, but serious arboviruses endemic to the Boston region are West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE), which are both spread by mosquitoes. Rising temperatures and

⁶ Kennedy, E., Olsen, H., Vanos, J., Vecellion, D.J., Desat, M., Richters, K., Rutledge, A., Richardson, G.R.A. (2021). Canadian Journal of Public Health. 112, 4: 706-713.

⁷ Hoehne CG, Hondula DM, Chester MV, Eisenman DP, Middel A, Fraser AM, Watkins L, Gerster K. Heat exposure during outdoor activities in the US varies significantly by city, demography, and activity. Health Place. 2018 Nov;54:1-10. doi: 10.1016/j.healthplace.2018.08.014. Epub 2018 Sep 7. PMID: 30199773.

⁸ Centers for Disease Control and Prevention. (2011). Nonfatal sports and recreation heat illness treated in hospital emergency departments – United States, 2001-2009. Morbidity and Mortality Weekly Report. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6029a1.htm>.

⁹ Heylen D, Lasters R, Adriaensen F, Fonville M, Sprong H, Matthysen E. Ticks and tick-borne diseases in the city: Role of landscape connectivity and green space characteristics in a metropolitan area. Sci Total Environ. 2019 Jun 20;670:941-949. doi: 10.1016/j.scitotenv.2019.03.235. Epub 2019 Mar 16. PMID: 30921726.

above-average precipitation contribute to the increase in the range and prevalence of insect vectors.¹⁰ As temperatures rise and recreational use of green spaces increases, so does the potential for infection. The MA Arbovirus Surveillance and Response Plan provides surveillance and detailed response guidance for preventing and controlling arboviruses. Consistent with the plan, the MA Department of Public Health (MDPH) monitors infections of EEE and WNV. Since 2000, there have been 221 cases of WNV among Massachusetts residents resulting in at least 12 deaths and 43 cases of EEE resulting in at least 22 deaths.¹¹

Increased temperatures and precipitation also promote the spread of water-borne toxins, such as Cyanobacteria (algal blooms). Ingestion or inhalation of small amounts of cyanobacteria or cyanotoxin can cause gastrointestinal or respiratory symptoms, respectively, while ingesting larger amounts may cause liver or neurological damage. Physical contact with cyanobacteria can cause skin or eye irritation (MDPH, 2021). Studies suggest that increasing global temperatures are favorable to the growth of Cyanobacteria in stagnant water bodies such as lakes and ponds. Response to Cyanobacteria is primarily conducted at the local municipal level with some guidance from the MDPH (MDPH, 2021). Even though local health departments typically issue algae bloom advisories, warm season water recreation may increase risk of exposure.

Allergens

Exposure to allergens has also increased as rising temperatures lengthen the growing season. Earlier, warmer spring temperatures and longer summers contribute to earlier and more abundant pollen production. The ragweed growing season has already increased by over two weeks since 1995 in northern states (Resilient MA, 2021). As a result, the number of people with allergy symptoms has increased and people who may have experienced only mild symptoms before are reporting worse symptoms. According to Climate Central, in 1970 only about 10% of Americans suffered from hay fever, which is caused by airborne allergens like mold spores and pollen, but by 30% of people suffered from hay fever by 2000.

Drowning

People frequently engage in water-based recreation to both enjoy and cope with hot summer temperatures. Multiple studies have found significant associations between hotter temperatures and higher rates of drowning for both adults and children. Men are more likely to die by drowning than women and children are at greatest risk of drowning during hot days than any other group. Compared to 15° C (59°F), a temperature of 30° C (86° F) was associated with 6 times the change of drowning among children and youth ages 0 to 19, according to a study of drowning-related hospitalizations in Quebec, Canada between 1989 and 2015. Drowning is a leading cause of death among children, while many survivors experience long-term health problems. Drowning deaths are not equally borne across racial groups. Black and Indigenous

people are 1.5 and 2 times more likely to die from drowning, respectively, than White people (CDC, 2021). These disparities are much worse among children. Black children ages 10 to 14 are 7.6 times more likely to die by drowning than White children (CDC, 2021). In Massachusetts, at least 29 drowning deaths have been reported between May and June 2021.

Inequities in Access to Open Space and Recreational Resources

Populations with fewer barriers to open space and recreational resources generally experience greater health benefits relative to groups with less access, despite the potential exposures described above. Historically low public and private investment in neighborhoods primarily home to Black, Indigenous, and People of Color (BIPOC) has resulted in disproportionately fewer green spaces and higher rates of associated adverse health outcomes in these communities. Further, an examination of heat risk-related land cover characteristics across different racial and ethnic groups and level of residential segregation revealed that in the United States, there is a pattern of racial/ethnic disparity in the form of low canopy coverage in BIPOC neighborhoods.

Disproportionate drowning deaths among BIPOC individuals is at least partly due to a legacy of institutional and sometimes violent exclusion of these communities from recreational spaces. Low-income and BIPOC children are much less likely to know how to swim than their White and more affluent peers, according to a 2017 study published by the USA Swimming Foundation. Children’s swimming ability is directly tied to that of their parents. Children with parents that report good swimming ability are 4.3 times more likely to have good swimming ability, pointing to the intergenerational nature of the issue. Decades of segregation at public swimming pools and beaches created a legacy of not swimming among Black communities, and these recreational spaces have often been sites of racially motivated violence. Even today, BIPOC frequently reports experiencing harassment at beaches and public pools. Fees and disinvestment in recreational resources can inadvertently perpetuate racial inequities. Today, parents are more likely to cite time and financial barriers for not signing up their children for swim lessons. “As parks agencies across the country increasingly turn to fees to bolster weak budgets, aquatics programming is often one of the first, and most lucrative, areas to which they turn.”¹²

It is also worth noting that the presence of urban green and recreational space has the potential to yield sociodemographic changes that may lead to further marginalization. Perceived health benefits of living near green space, in combination with environmental, recreational, and aesthetic benefits cause property value to rise with proximity to green space. While additional research is needed in this area, there is evidence that suggests an association between the presence of greenspace and gentrification trends.

Research Gaps

¹² Wang, Vivian. (2017). Closing a Racial Divide, One Swim Lesson at a Time. The New York Times. <https://www.nytimes.com/2017/08/27/nyregion/new-york-city-swim-lessons.html>

Additional research could elucidate the specific drivers of outdoor heat exposure and outdoor heat-driven heat illnesses among different demographics and across different climates. More research is also needed to better understand the relationship between green spaces and gentrification trends, including strategies to mitigate potential displacement impacts.