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EDITORIAL COMMENT

Ambient Temperature and Myocardial Infarction

Who Is at Risk?*

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Due to climate change, extreme weather events will occur more frequently across the globe. It has been estimated that over the last 30 years, 37% of heat-related deaths were attributable to human-induced climate change, with an increasing incidence of temperature-related deaths observed across all continents.[1] Understanding the relationship between environmental exposures and our health has never been more pertinent.

There is growing evidence that ambient temperature is associated with an increased risk of adverse cardiovascular events. A relationship between adverse seasonal temperature exposure and myocardial infarction was first observed almost 100 years ago.[2] A U-shaped association between ambient temperature and myocardial infarction has been found, which indicates that there is an increased risk of myocardial infarction in both the extremes of cold and warm temperatures.[3-5] This observation has been made globally, across different latitudes, meteorological conditions, and populations. Perhaps unsurprisingly given the heterogeneity in study design and study populations, the effect size is variable. A greater increase in relative risk of myocardial infarction has generally been observed at lower latitudes, possibly reflecting the broader range of seasonal temperature change and higher frequency of extreme weather events at latitudes above 50°. There is also evidence of adaptation, with populations in colder climes having a smaller change in the incidence rate of myocardial infarction during cold weather than countries with warmer climes.[6]

Interestingly, variation in the effect size is also observed within local populations who are exposed to similar environmental factors. Although the role for sex remains less clear, age seems to modify the risk between ambient temperature and myocardial infarction: individuals aged >65 years are more susceptible to cold-related myocardial infarction than those <65 years of age.[6,7] So far, no interaction has been found for ischemic heart disease, diabetes, or smoking.[8-10] However, at this point, the number of studies that evaluated the modifying role of cardiac risk factors is scarce. More insight into how the relationship between ambient temperature and myocardial infarction is influenced by risk factors for coronary artery disease may help us to identify those who are at risk. This is needed not only to determine those most susceptible to these environmental factors but also to enable the development of individualized prevention strategies for myocardial infarction.

It is in this context that Tseng et al,[11] in this issue of *JACC: Asia*, report the relationship between daily ambient air temperature and myocardial infarction across different groups with risk factors for coronary artery disease. The authors used routinely collected health care data records, available in 99% of the Taiwanese population, linked to meteorological data. They identified 319,737 incident cases of myocardial infarction over 299 million person-years. Hierarchical clustering was used to identify groups in whom the incidence of myocardial infarction varied. Consistent with existing literature, they report a U-shaped relationship between ambient temperature and incidence of myocardial infarction. Three distinct clusters were identified: 1) individuals <50 years of age; 2) individuals ≥50 years of age without hypertension;

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and 3) individuals ≥50 years of age with hypertension. The incidence of myocardial infarction differed in these groups, with 16 per 100,00 person-years in individuals <50 years of age, 105 per 100,00 person-years in individuals aged ≥50 years without hypertension, and 388 per 100,00 person-years in individuals aged ≥50 years with hypertension. Older individuals with hypertension seem to be more susceptible to cold-related myocardial infarction, whereas heat-related myocardial infarction was more prevalent among younger individuals. Hence this study shows that apart from age, hypertension seems to play a role in the relationship between ambient temperature and myocardial infarction.

Tseng et al[11] should be commended on the scale and inclusivity of their study. Their approach is an example of how routinely collected data can be used to address major challenges facing our society. They are the first to address how 6 important risk factors for coronary artery disease (age, sex, hypertension, hyperlipidemia, diabetes, and chronic renal disease) interact and influence the relationship between ambient temperature and myocardial infarction.

There are important limitations to this study[11] that are worth mentioning. Due to limitations in the data available, a meticulous evaluation on other established risk factors for coronary artery disease and environmental factors, particularly air pollution, was not possible. Transient exposure to air pollution is a recognized trigger for myocardial infarction[12,13] and can modify the effect of temperature-related events.[14] Laboratory and pharmacologic data could have been valuable to refine the severity of comorbidities and allow evaluation of the protective effect of medications (eg, antiplatelet therapy). Furthermore, proposed mechanisms of temperature-related myocardial infarction range from thrombotic states to situations of oxygen-supply imbalance through changes in blood viscosity and heart rate.[15] The relationship between ambient temperature and various subtypes of myocardial infarction according to the Fourth Universal Definition of Myocardial Infarction may differ, particularly for type 2 myocardial infarction.[16] An analysis stratified according to subtype of myocardial infarction would be highly informative.

Further research is required to understand the underlying mechanisms of temperature-related myocardial infarction but the cause and consequence of temperature change are undeniable. By identifying those who are at greatest risk in extreme weather conditions, we may be able to use targeted alert systems or prompt societies to consider how new and existing homes, places of work, and transport systems are adapted to protect the most vulnerable. Tseng et al[11] have shown us who can handle extreme temperatures, but can we act to protect those who cannot, with the goal of limiting the impact of climate change on those who are most susceptible?

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