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Brief Commentary

Go take a hike: The effects of nature experiences on inflammation

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It is ancient wisdom that time spent in nature can be healing for the mind and body. The millennia old quote by Hippocrates, "Nature itself is the best medicine", is referenced and receives empirical support in an exciting new paper by Ong et al. (2024) recently published in Brain, Behavior, and Immunity. In an age when we spend increasing quantities of time indoors staring at screens, growing evidence suggests that the opposite, exposure to natural environments, is protective against psychological stress, depression, and multiple chronic diseases like cardiovascular disease and cancer (Kuo, 2015). This broad swath of health outcomes impacted by exposure to natural environments suggests an underlying mechanism that can have similarly broad impacts on mental and physical health. Because elevated systemic inflammation can have such broad effects on mental and physical health (Kuo, 2015), Ong et al. (2024) asked: Is the frequency of pleasant green space encounters associated with lower inflammation?

In a large sample of middle-aged adults in the United States (Midlife in the United States (MIDUS dataset)), they found that a self-reported measure integrating the frequency of exposure to green space and the pleasantness of those experiences was related to lower levels of an index of inflammatory markers, particularly C-Reactive Protein. These effects were over and above those of exercise, which they adjusted for in their models. This correlational evidence is supported by experimental evidence on upstream physiological pathways known to impact circulating inflammatory markers. A walk in greenspace, relative to a walk in an urban environment, reduces amygdala activity to social threat (Sudimac et al., 2022). Consistent with influences of the amygdala on sympathetic nervous system activity, a walk in green space, relative to a walk in an urban area, is also associated with reduced urinary noradrenaline and adrenaline (Li et al., 2011). Similarly, time in nature can increase parasympathetic nervous system activity, as indexed by high frequency heart rate variability (Kondo et al., 2018). These effects of walks in green space relative to urban space on the sympathetic and parasympathetic arms of the autonomic nervous system would be expected to reduce systemic inflammation (Way and Uchino, 2024). These experimental studies indicate that the correlation reported by Ong et al., (2024) is likely to be as much due to the effects of greenspace exposure on inflammation as the other way around. This paper is the first large-scale study based in the United States providing evidence of such a link between nature exposure and inflammation, which provides promising avenues for future work.

This exciting new work leaves the question open as to how nature exposure may be reducing inflammation. We focus here on three potential pathways: a) a psychological pathway; (b) a social pathway; and (c) an immunological pathway. Psychological stress is a known driver of inflammation; because the pleasantness of the nature experiences reported by Ong et al. (2024) were related to inflammation, it suggests a reduction in stress may be a potential mechanism. The alterations in amygdala activity and autonomic nervous system activity after nature exposure described above are consistent with this interpretation. Intriguingly, another component of the effects may be social (Goldy and Piff, 2020). The majesty of nature can trigger experiences of awe, which, in turn, leads to feelings of oneness with others, trust, and

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belongingness. Because social integration is associated with reduced inflammation (Uchino et al., 2018) influences of nature on social relationships could be another element contributing to lower inflammation.

An immunological pathway that may underlie the effect of nature exposure on inflammation is articulated in the "old friends" hypothesis: decreased exposure to beneficial microbes as a result of urbanization has led to impaired regulation of inflammation (Rook, 2013). This would be consistent with the rapid rise in inflammation-related diseases concurrent with population shifts from farms to cities over the last century. The plants and soil in natural environments contribute microbiota that become airborne allowing them to be inhaled and ingested when one is in or near greenspace. It is theorized that these microbes can then influence the human microbiome in the gut and other organs. As the gut microbiome is an important regulator of inflammation (Way and Uchino, 2024), this may be a potential pathway underlying the effects documented by Ong et al. (2024). Identifying and confirming such pathways will be an important area of future research. With such knowledge, it may be possible to remedy socioeconomic disparities in access to greenspace and the corresponding microbial disparities that likely contribute to higher inflammation and poorer health outcomes amongst those with lower socioeconomic status.

As research in this field progresses, it is possible that providing access to public parks and nature areas in every community will become as important as providing access to hospitals and clinics. At the individual level, perhaps doctors should prescribe a daily walk in a park as a first step in treatment of elevated inflammation rather than medications, which can be expensive and laden with side effects. The work of Ong et al. (2024) suggest that the old doctor's line about "take two aspirin and call me in the morning" to reduce the effects of inflammation could be revised to "Go take a hike and call me in the morning."

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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