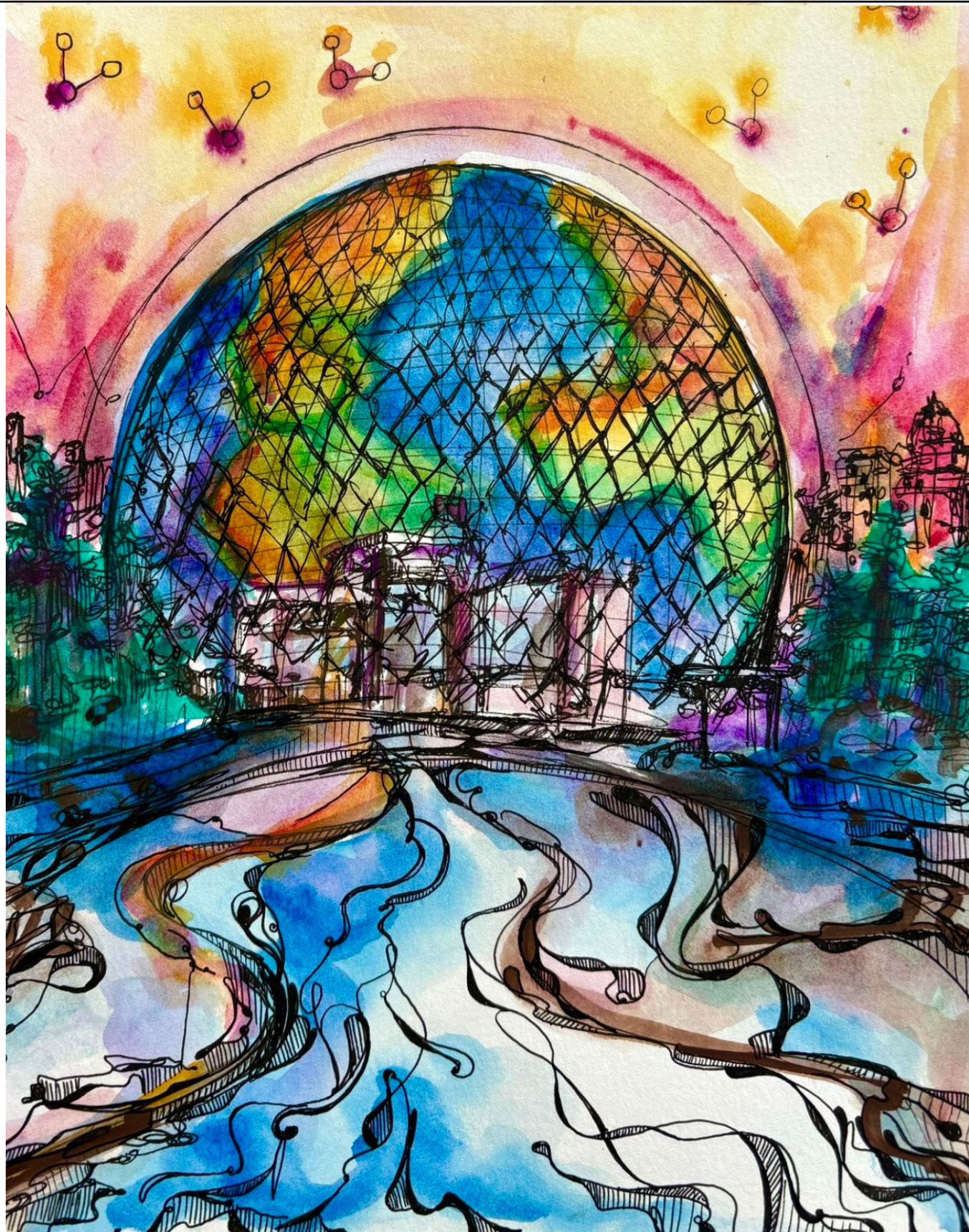


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Socioeconomic Disparities, Chronic Stress, and Neurodegeneration: A Canadian Policy Perspective on Risk Reduction

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Introduction

Neurodegenerative diseases, such as Alzheimer's and Parkinson's disease, impair the brain's functionality [1]. Global aging, driven by improved nutrition, sanitation, education, and healthcare, has increased neurodegenerative disease prevalence [2-3]. While aging remains the most significant risk factor for neurodegenerative diseases [4], research has shown that chronic stress, which is more prevalent amongst individuals of low socioeconomic status (SES), is a critical factor contributing to the onset and progression of neurodegeneration [5-6]. Individuals with lower SES experience heightened stress due to a range of factors, including financial instability and poor housing [6-8]. Chronic stress drives neuroinflammation [5, 9], oxidative stress [5, 10], and behavioral changes [6-7], all of which accelerate neurodegeneration. Therefore, addressing the structural causes of chronic stress, particularly those linked to SES disparities, is crucial in mitigating the rising incidence of neurodegenerative diseases. This perspective synthesizes literature to propose a framework linking socioeconomic status, chronic stress, and neurodegeneration and discusses how policy interventions with a focus on the Canadian context can address structural stressors to reduce neurodegenerative disease risk.

Mechanisms Linking Stress and Neurodegeneration

Many pathways link stress and neurodegeneration (Figure 1). Stress activates the body's hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, leading to the release of cortisol, epinephrine, and other stress hormones [11-13]. Chronic exposure to these hormones impairs neuroplasticity, increases glutamate toxicity, and decreases neurogenesis, all of which contribute to neuronal death and the development of neurodegenerative diseases [5, 12, 14]. Stress-induced neuroinflammation also plays a crucial role in this process. Pro-inflammatory cytokines, which are upregulated during stress, activate pathways that promote neuronal damage and protein aggregation, which are key features of neurodegenerative diseases [5, 9, 15-17]. Additionally, stress induces oxidative stress, disrupting mitochondrial function and activating cell death pathways. Behavioral changes, including poor nutrition, sedentary lifestyle, smoking, and poor sleep quality, which are more common in low-SES populations, exacerbate these effects,

creating a vicious cycle that accelerates neurodegeneration [7, 18].

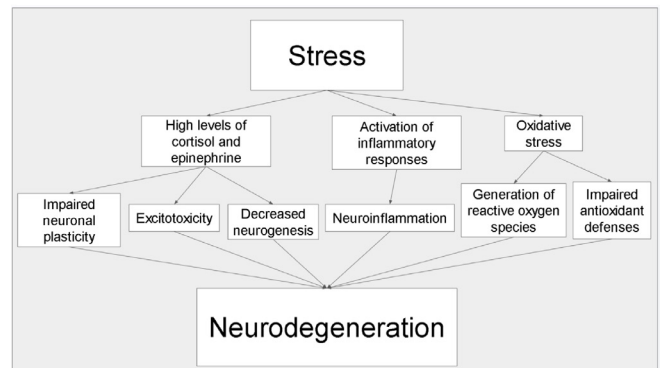


Figure 1. Non-exhaustive pathways of how stress can lead to neurodegeneration

Socioeconomic Status and Chronic Stress

The relationship between SES and stress is well-documented. Baum et al. [6] propose a pathway that describes how SES can impact stress exposure. Specifically, low-SES individuals experience more stress because of a lack of resources and adverse environmental condition, such as more hazards and pollution. Additional pathways through which low SES increases stress and exposure are discussed below (Figure 2).

Individuals from lower socioeconomic backgrounds are more likely to experience chronic stress due to factors such as financial insecurity, low educational attainment, poor housing conditions, and limited access to healthcare [6-8, 19, 20]. Furthermore, low-SES individuals face environmental stressors like pollution and unsafe housing [6,21-22]. Occupational stress is also more prevalent among low-SES populations, with many working in high-stress, low-wage jobs that offer limited job security and benefits [23-25]. Moreover, low social status exacerbates stress through various mechanisms, including discrimination, stigma, and social exclusion, which reduce access to supportive social networks and hinder effective coping strategies [26]. The cumulative effect of these stressors is a heightened vulnerability to chronic stress, which increases the risk of neurodegeneration. In addition to the direct impact of stress, low-SES individuals may face barriers to accessing resources that could mitigate the effects of stress, such as mental health services, nutritious food, and physical activity opportunities [23-24].

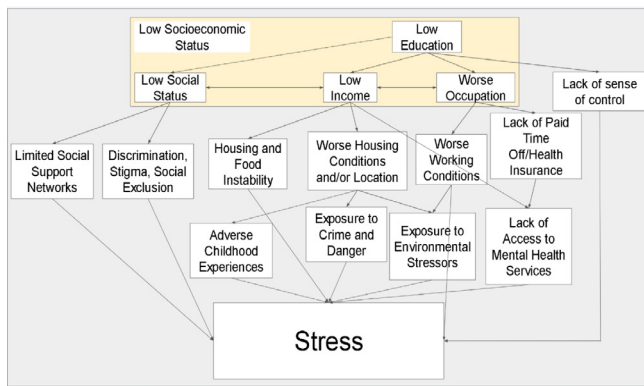


Figure 2. Non-exhaustive pathways of how low socioeconomic status increases stress and impairs an individual's ability to regulate their stress

This exacerbates their stress burden and can increase their risk for neurodegenerative diseases. The cumulative effect of these stressors is a heightened vulnerability to chronic stress, which increases the risk of neurodegeneration. In addition to the direct impact of stress, low-SES individuals may face barriers to accessing resources that could mitigate the effects of stress, such as mental health services, nutritious food, and physical activity opportunities [23-24]. This exacerbates their stress burden and can increase their risk for neurodegenerative diseases.

Policy Solutions to Address Stress and Neurodegeneration

Addressing the intersection of SES, chronic stress, and neurodegeneration requires targeted policy interventions with demonstrated effectiveness. Focusing on the Canadian context, this section highlights two key domains where such interventions have shown promise in mitigating chronic stress among low-SES populations: minimum wage policies and housing affordability initiatives.

Empirical evidence from Canada suggests that raising the minimum wage is associated with improved mental health and reduced financial strain. A study using data from Statistics Canada's National Population Health Survey (1994–2001) found that increases in provincial minimum wages correlated with lower levels of psychological distress and depressive symptoms, particularly among low-wage workers [27]. Similarly, a comparative analysis of 24 OECD countries, including Canada, found that higher minimum wages contributed to improved population health by reducing poverty rates, increasing access to healthcare, and lowering smoking prevalence, likely via reduced financial stress [28]. Together, these findings suggest that increasing minimum wages may be an effective structural intervention for alleviating chronic stress in low-SES individuals and, by extension, reducing stress-related neurodegeneration. Access to affordable housing is another critical determinant of stress among low-SES populations. A study in Ontario found that access to subsidized housing led to significant reductions in depressive symptoms and general distress over a 6 to 18 month period [29]. More recently, LeLoup et al. [30]

analyzed 2018 Canadian Housing Survey data and found that long-term, social housing had the most substantial positive effect on renters' economic well-being. Social housing, defined as housing provided or subsidized by governments or non-profits at below-market rates for those in financial need, offers both affordability and long-term tenure security, which are essential for reducing stress linked to housing precarity.

Importantly, these findings do not align well with the Canada Housing Benefit (CHB), introduced as part of the federal National Housing Strategy in 2017. The CHB aims to help low-income Canadians pay rent by providing direct, portable financial assistance [31]. While it aims to increase housing accessibility, it is sensitive to market volatility, such as rising rents and housing shortages, making it a less stable or effective long-term solution for stress reduction. Subsequently, LeLoup et al. [30] found that direct monetary transfers like the CHB had little measurable impact on renters' overall economic well-being. Therefore, the focus of housing accessibility policies should be on expanding social and non-market housing, which has the greatest potential to improve economic well-being and reduce stress associated with housing insecurity, particularly for those in greatest need.

Conclusion

This paper has explored the relationship between SES, chronic stress, and neurodegeneration, highlighting the role of stress in exacerbating the risk of neurodegenerative diseases. Low-SES individuals are more likely to experience chronic stress, which, through mechanisms such as neuroinflammation and oxidative stress, contributes significantly to the development of neurodegenerative diseases. In Canada, policymakers must address the structural drivers of SES-related stress by specific measures, such as increasing the minimum wage and improving housing accessibility, to reduce the burden of neurodegenerative diseases. Coordinated efforts across all levels of government, alongside community partnerships, are essential. Targeted policy interventions that address the root causes of chronic stress can help reduce a modifiable risk factor for neurodegeneration, promoting healthier and more equitable aging.

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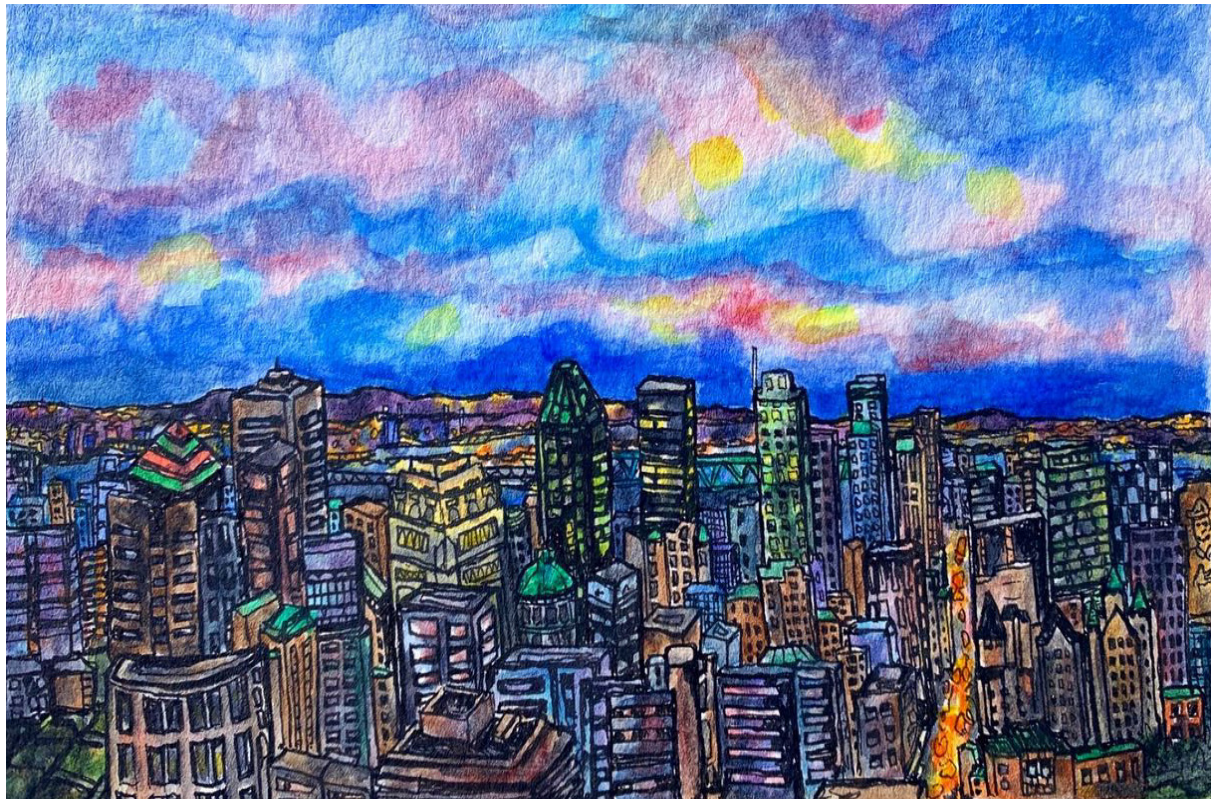
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