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PERSPECTIVAS
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Air pollutants as a risk factor for cognitive impairment and dementia

Poluentes do ar como fator de risco para o desempenho cognitivo e demência

Contaminantes atmosféricos como factor de riesgo para el desempeño cognitivo y la demencia

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Introduction

Population aging and cognition

Numerous advances in the last 100 years, principally in access to new technologies, goods and services, medical care, and expanded availability of medicines, have led to a major increase in the population's life expectancy worldwide. This has made population aging one of the most important global transformations in human life. However, some nations, especially low and middle-income countries, will experience this increase in life expectancy (and consequently in the elderly population) at an unprecedented pace when compared to the same phenomenon in Europe and North America. These countries will thus have to prepare quickly to deal with a growing burden of highly common diseases at more advanced ages [1].

Currently, an estimated 12% of the global population is over 60 years of age, and projections show that the elderly will represent 21.5% of the world population by the end of this century. It will be the first time in human history that there will be more old people than young people [2]. In this context, cognitive aging and the diseases resulting from this process pose a major challenge for healthy aging. Importantly, normal cognitive aging involves a natural and dynamic process that includes modifications in biological functioning (molecular, cellular, histological, and organic), psychiatric functioning (cognitive and psycho-affective dimensions), and social functioning [3,4,5]. Healthy aging can thus be accompanied by a certain decline in cognitive reserves, but which does not interfere substantially in daily activities. In other cases, when cognitive aging is not successful, there is a sharper decline in cognition, which may be linked to factors extrinsic to the individual, such as sedentary lifestyle, smoking, low schooling, alcohol and drug consumption, and exposure to air pollution.

Air pollutants and human health

In the last 40 years, studies on the impacts of air pollutants, especially in cities, are unanimous in associating greater length of individual exposure to air pollutants with elevated risk of developing inflammatory processes, diseases of the respiratory system, and cardiovascular problems. In most cases, the elderly and children are the most susceptible to developing these diseases. According to

recommendations by the World Health Organization (WHO), various countries have adopted more rigorous limits on the concentration of air pollutants. However, even today, 91% of the world population lives in cities where the air quality exceeds the limits suggested by the WHO [2]. As a consequence, in 2016, 8% of all deaths in the world were attributed to exposure to air pollutants, especially in large urban areas, where the main source of emissions is motor vehicle traffic. Collectively, air pollutants consist of a complex and diverse mixture of chemical substances with the capacity to cause harm or discomfort to humans. Such pollutants are thus now the second leading cause of deaths from non-communicable diseases, after smoking, whereas the latter can be avoided by the individual, unlike exposure to environmental air pollutants. In Brazil, despite the data's limitations, an estimated 66,000 yearly deaths are attributed to exposure to air pollutants annually [2]. However, this number may be even higher, since projections for the next 15 years only for the State of São Paulo state that if nothing is done, exposure to air pollutants will be the cause of 250 thousand deaths, one million hospitalizations at a cost of 1.5 billion BRL only in the state of São Paulo [6,7].

In relation to the harmful effects of air pollution on cognitive performance, a cohort study of 2.1 million persons in Ontario, Canada, showed a positive association between fine particulate matter ($PM_{2.5}$), even at low concentrations, and incidence of dementia [8]. In Sweden, a study of 1,806 adult volunteers found a positive association between air pollutants and increased incidence of dementia and Alzheimer's disease [9]. In Taiwan, two cohort studies, the first with 96,000 and the second with 30,000 volunteers, found that exposure to the pollutants nitrogen dioxide (NO_2), fine particulate matter ($PM_{2.5}$), ozone (O_3), and carbon monoxide (CO) was also associated with increased incidence of dementia [10,11]. Taken together, these studies suggest that prolonged exposure to air pollutants, especially those produced by motor vehicle traffic in large cities, like particulate matter, show a positive association with cognitive decline and increased incidence of dementia [12,13]. This association is biologically plausible, because once inside the body, these pollutants can trigger chronic and systemic inflammation, besides directly harming the nervous system [14,15,16,17,18,19].

Finally, it is important to recall that before individuals present dementia per se, a smoldering process of cognitive impairment occurs, which is not sufficiently serious in the beginning to lead to functional loss and interfere in quality of life. However, this cognitive impairment is of great importance for early diagnosis of risk factors for dementia at more later ages [1,20].

Timeliness of the study

Brazil and its Latin American neighbors are experiencing an accelerated and irreversible process of population aging. In addition, many countries have cities whose air pollutant emissions fail to comply with the WHO guidelines [2]. Meanwhile, according to forecasts for 2030, 63% of the world population with dementia will be living in low and middle-income countries [1]. Thus, studies that seek to identify and understand possible environmental risk factors and their influence on the pathological cognitive aging process in young and middle-aged adults are highly important for avoiding such outcomes in the future. Research on chronic exposure to air pollutants and their role in neurodegenerative processes in young and elderly populations take on great importance in a scenario of growing life expectancy and high emissions of air pollutants.

Final remarks

The relationship between exposure to air pollutants and neurodegenerative outcomes is still not fully established, but it is already considered a global concern. Many countries, including most of the Latin American nations, still lack data and studies that seek to understand this association in their realities, which indicates a relevant gap. In the coming years, Brazil and other Latin American countries should thus make progress in their understanding of the association between air pollutants and cognitive outcomes, aimed at minimizing the impact of this association in order to provide individuals with healthier aging in urban settings.

Contributors

D. R. R. Silva contributed to the planning, execution of the study and revision and approval of the final version approved for publication. C. K. Suemoto and N. Gouveia contributed to the research proposal's development, writing of the manuscript and approval of the final version approved for publication .

Additional informations

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