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Urban Green Space as a Solution for Degenerative Diseases: A Perspective Based on a Literature Review

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ABSTRACT

The research aimed to analyse factors contributing to degenerative diseases, including exposure to chemicals and air pollution. This research is a literature review focusing on various environmental factors that contribute to degenerative diseases and presents a solution perspective involving the creation of green spaces as a means to mitigate the impact of these factors. The literature was collected by searching metadata on the following page: https://www.scopus.com/search/form.uri?display=basic#basic, using the keywords "degenerative diseases" and "pollutant". The data selection using the PRISMA method to identify the most relevant literature for reference in this research study. Each type of pollution or environmental factor contributing to degenerative diseases has been systematically analysed using NVivo 12 Pro. In total, 35 research titles explore different factors responsible for degenerative diseases, with a particular focus on environmental factors. The results of the analysis conducted by researchers based on these 35 articles were mapped using NVivo 12 Pro, categorizing them according to the types of factors responsible for degenerative diseases. It is noteworthy that the majority of these studies focused on the neurodegenerative type. Furthermore, from the pool of 35 selected articles, air pollution emerged as the most dominant cause, constituting 57% (20 articles) of the total literature.

1. INTRODUCTION

Based on the type, degenerative diseases are grouped into cardiovascular, neoplastic, and neurodegenerative. The most common cardiovascular symptoms are hypertension, coronary heart disease, and heart attack. Neoplastic is a disease associated with abnormal growths such as tumours or cancer. Finally, neurodegenerative takes the form of conditions that affect the nervous system, such as Parkinson's and Alzheimer's [1]. Research shows that living near green spaces can reduce the risk of death from neurodegenerative diseases for elderly people because they avoid potential air pollution [2]. Pollutants cause most cardiovascular degenerative diseases, so they have strong association between greenery and cardiovascular disease (CVD) risk. Several studies report that residential proximity to greenery reduces cardiovascular mortality and adverse cardiovascular events [3]. Although the mechanisms underlying this relationship are not well understood, the beneficial health effects of greenery have been linked to its ability to relieve stress, reduce air pollution, and encourage physical activity [4, 5]. Vegetation in residential neighbourhoods can also increase access to healthy goods and services and social interactions. Research on the health impacts of greenery can provide new insights into the environmental determinants of CVD risk [6]. It can inform the development of greenness-able-based strategies to prevent CVD and its clinical manifestations.

Studies have demonstrated that residing in large cities with a greater amount of green space can reduce the risk of cardiovascular diseases [6, 7]. These associations were consistent among participants aged 40 and older, both men and women, and across high and low-income groups. Additional research was undertaken to explore the impacts of heightened utilization of green spaces and area-level alterations in green space availability. These findings emphasize the significance of urban planning policies aimed at augmenting green infrastructure and expanding green space coverage in urban areas as a preventive measure against cardiovascular disease (CVD) risk [8].

Green open space is generally defined as an infrastructure with a planned open nature concept [9]. The concept of green infrastructure refers to an interconnected open space that spans urban and rural environments, linking living ecosystems and water ecosystems [10]. Planned green open spaces offer valuable benefits to humans by fostering sustainable ecosystems within them. These spaces have proven to be particularly helpful for countries dealing with significant climate change, such as providing cooling effects during hot summer periods [11-13]. A well-designed model of green open spaces can play a crucial role in addressing pollution in urban areas. Research conducted in one of the cities with the highest pollution levels has revealed that even with a 33% green open space coverage, it is still insufficient to fully enhance air quality in Jakarta [4].

Criteria for a quality green open space encompass its proximity to water sources, including rivers, lakes, and reservoirs [5]. Green open spaces are predominantly developed in urban areas and are commonly referred to as urban green spaces. Green open space includes all arrangements of trees, such as city parks and all green belts, and water sources as a stabilizer of the earth's surface temperature due to the high specific heat (s) of water which exists in a city. These areas are often referred to as the "lungs of the city" due to their role in mitigating rising environmental temperatures and enhancing air quality [14]. They achieve this by lowering air temperatures and absorbing and purifying atmospheric pollutants through the process of photosynthesis carried out by the trees within these spaces [15-17]. Moreover, the planting of trees and the establishment of green spaces represent a practical approach to mitigating air pollution. Green open spaces can be intentionally designed to meet the requirements of the area, addressing existing pollution concerns while nurturing an ecosystem that sustains the development of green spaces for the benefit of the human population inhabiting the vicinity.

Green spaces also enhance pedestrian comfort and serve as sports areas. While outdoor sports are an option, time constraints often lead people to prefer exercising in their local surroundings. Unfortunately, the desire of many in the community is frequently thwarted by the limited availability of open land in urban areas. Exercising in open areas tends to yield better athletic results compared to indoor spaces. This is because, in open spaces, individuals benefit from fresher air and improved air circulation, unlike enclosed environments [9]. Sports conducted in green open spaces within residential areas are not only more cost-effective but also affordable for the community. By optimizing the utilization of green open spaces, these areas can serve as accessible venues for people to engage in physical activities. Overall physical activity levels were also higher among residents of greener environments, but this only partially explains the link between green spaces and health. Although environmental drivers of physical activity will vary by type, a better understanding of the determinants of overall physical activity levels can help inform population-wide approaches to increasing physical activity levels [5, 18]. Over the course of a decade of research, this study seeks to explore the pattern of pollutant influence on degenerative diseases and assess potential solutions through the development of green spaces. The research will analyse factors contributing to degenerative diseases, including exposure to chemicals and air pollution. The key questions addressed in this study are as follows:

- What is the research trend regarding the impact of pollutants on degenerative diseases over the past decade?
- What are the characteristics of research on the impacts of pollutants on degenerative diseases concerning the authors' country, journal, and publication indexing?
- How does the presence of green space address degenerative diseases caused by pollutants?

2. METHOD

This research is a literature review focusing on various environmental factors that contribute to degenerative diseases and presents a solution perspective involving the creation of green spaces as a means to mitigate the impact of these factors, effectively serving as the "lungs" of the city. The literature was collected by searching metadata on the following page: https://www.scopus.com/search/form.uri?display=basic#basic, using the keywords "degenerative diseases" and "pollutant," resulting in a total of 303 metadata records. Subsequently, the data underwent selection using the PRISMA method to identify the most relevant literature for reference in this research study. The selection process, from search to final selection, is outlined in Figure 1 below.

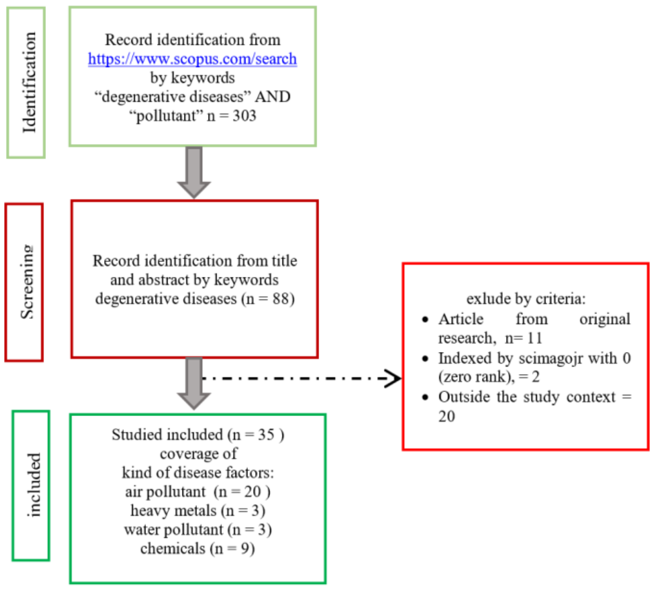

Figure 1. PRISMA flowchart

Following the literature selection, each piece of literature received a code comprising two numbers representing the publication year, a search number ranging from 1 to 88 (according to the order of screening), a specific code "N" for Neurodegenerative diseases, and codes for the type of pollution as follows:

- Air (pollution from air).
- Water (water pollution).
- Metal (heavy metals such as Pb and Hg).
- Chemical (pollution from chemicals such as solvents or organic compounds).

Each type of pollution or environmental factor contributing to degenerative diseases has been systematically analysed using NVivo 12 Pro.

3. RESULT AND DISCUSSION

An in-depth analysis of the entire selected literature has been conducted to address the research questions. In total, 35 research titles explore different factors responsible for degenerative diseases, with a particular focus on environmental factors. The discussion encompasses research trends across countries and the journals that have published the selected research within this study. It also delves into the factors that contribute to the rise in degenerative diseases stemming from environmental factors, including air and water pollution and environmental chemicals.

3.1 Characteristics of research publications

Table 1 shows that the country that predominantly focuses on reviewing research on the potential of environmental pollution for the development of degenerative diseases is the USA, with five publications, followed by Brazil, China, Mexico, and Taiwan, with three studies each over the last ten years. The USA is the most dominant in this discussion, showing more attention to environmental factors in degenerative diseases. One of the studies discussed from the USA was the New York Department of Health SPARCS (Statewide Planning and Research Cooperative System), which focused on studying air pollution by measuring PM2.5 concentrations which significantly worsened degenerative disease sufferers over a long period [19].

Table 1. Characteristics of the literature by country of the authors

Country	f	Cited First Author
Bangladesh	1	Rana et al. [20]
Brazil	3	Corrêa et al. [21], Bittencourt et al. [22], Toro et al. [23]
Canada	1	Silveira and Meaney [24]
China	3	Liu et al. [25], Shou et al. [26], Ma et al. [27]
Columbia	1	Parks et al. [28]
Czech Republic	1	Honkova et al. [29]
India	1	Das et al. [30]
Iran	1	Jamshidi-Kia et al. [31]
Italy	2	Vinceti et al. [32], Filippini et al. [33]
Kazakhstan	1	Naseri et al. [34]
Korea	1	Kim et al. [35]
Luxembourg	1	Schymansk et al. [36]
Mexico	3	Bello-Medina et al. [37], Sánchez-Ocampo et al. [38], Mendoza-Magaña et al. [39]
Netherlands	2	Klompmaker et al. [40], Klompmaker et al. [41]
Nigeria	1	Arojojoye et al. [42]
Sweden	1	Ekström et al. [43]
Taiwan	3	Li et al. [44], Chuang et al. [45], Chen et al. [46]
United Kingdom	1	Pritchard et al. [47]
United States	2	Walker et al. [48], Barnhill et al. [49]
USA	5	Furman et al. [50], Nunez et al. [19], Suchy-Dicey et al. [51], Kang et al. [52], Parra et al. [53], Zhu et al. [54]

China is the next country that also focuses on studying pollution as a factor in degenerative diseases. Through its doubts about the direct impact of air pollution from increasing PM2.5 concentrations, one of the studies tries in vitro to show how this pollution directly impacts experimental animals already suffering from degenerative disease [25]. The problem of environmental pollution, especially which originates from the air as a source of life that contains oxygen and other necessary gases, has, of course, become a necessity for health and environmental observers to continue to study it. There is still a lack of publications on this study from various developed and developing countries, making it a challenge for each country to contribute to studying environmental impacts on health, especially since the outbreak occurred throughout the world during the COVID-19 pandemic, which demands various practical solutions to solving health problems, especially those originating from environmental pollution, both from non-biological chemicals and from bacteria and viruses (Table 2).

Table 2. Journals and indexes that publish articles in this study

Journal Name	f	Scopus Indexed
Advanced Science	1	Q1
Ecotoxicology and Environmental Safety	1	Q1
Environmental International	1	Q1
Environmental Health Perspectives	3	Q1
Environmental Health: A Global Access Science Source	1	Q1
Environmental Research	3	Q1
Environmental Research and Public Health	1	Q2
Environmental Science and Pollution Research	1	Q1
Environmental Science Processes & Impacts	1	Q1
Environmental Toxicology	1	Q2
Epidemiology	1	Q1
European Archives of Oto-Rhino-Laryngology	1	Q1
International Journal of Environmental Research and Public Health	1	Q2
International Journal of Molecular Sciences	3	Q1
Journal of Herbmed Pharmacology	1	Q3
Medical Hypotheses	1	Q2
Molecules	1	Q1
Nature Medicine	1	Q1
Neurobiology of Disease	1	Q1
Neuroscience	1	Q2
Neuroscience Letters	1	Q2
Neurotoxicology	2	Q2
Particle and Fibre Toxicology	2	Q1
Science of the Total Environment	1	Q1
Toxicological Sciences	1	Q1
Toxicology Letters	1	Q2
Toxicology Research	1	Q3

Another characteristic of the literature selected in this study pertains to the journals that publish it and their indexing on Scopus. It is evident that three journals primarily discuss studies on the factors contributing to degenerative diseases resulting from environmental pollution and have Q1 indexing. These three journals are Environmental Health Perspectives, Environmental Research, and International Journal of Molecular Sciences. Additionally, other selected journals for this research are highly indexed and globally renowned, chosen to ensure the inclusion of credible research for the discussion in this study.

3.2 Diverse environmental factors responsible for degenerative diseases and green space as a solution

The results of the analysis by researchers from 35 articles were then mapped with the help of NVivo 12 Pro based on the types of factors that cause degenerative diseases (Figure 2). Figure 2 shows that in most studies on environmental pollution factors in degenerative diseases, the overall literature states that the type is neurodegenerative. Furthermore, the most dominant cause from 35 literature was 57% (20 articles) of air pollution. Meanwhile, the most minimal factors include heavy metals and water pollution.

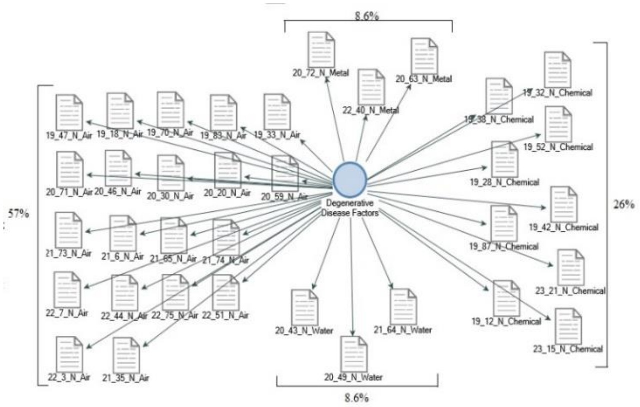

Figure 2. Degenerative disease factors mapping by NVivo

Degenerative disease is a disease caused by decreased organ function. The body experiences a deficiency in the production of enzymes and hormones, immunodeficiency, lipid peroxide, and damage to cells (DNA) and blood vessels. In essence, degenerative diseases are often characterized as a decline in organ function, typically associated with the aging process. However, there are instances when they manifest at a younger age, resulting in a deterioration of health, often leading to illness. These diseases can also be attributed to factors such as insufficient physical activity, unhealthy dietary habits, exposure to environmental and industrial toxins, and psychological stress [50]. Physical activity is a series of structured and rhythmic activities with a certain intensity over a certain period as a means or medium to improve health status through promotive, preventive, curative and rehabilitative efforts [55]. Physical exercise can burn a certain number of calories, thereby reducing the body's excess calories. Phenomena that occur in society along with the shift in the times have caused a change in diet from natural to modern. Unhealthy food choices and lifestyles are increasingly spreading, causing degenerative diseases. Today's lifestyle with a diet high in fat, salt and sugar, attending parties, liking eating out/restaurants, and canned and ready-to-eat foods can increase the potential for degenerative diseases.

Air pollutants can contain coarse and fine particulates in the form of organic and inorganic compounds, namely heavy metals, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds. Air pollutants can penetrate the lungs and cardiovascular system through the respiratory process and cause stroke, heart disease, and lung cancer [1]. Pollutants in the form of carbon monoxide (CO) compounds as a result of incomplete combustion of organic compounds, especially isooctane and n-heptane in gasoline, can be 200 times stronger in coordinating bonds with the central $Fe^{2+ \text{ atom}}$ in the porphyrin ring in haemoglobin so that body cells experience a lack of oxygen. Oxygen (hypoxia), which can cause death. Air pollutants can also carry pathogenic bacteria, which increase the potential for degenerative diseases [28] and neurological disorders, including Alzheimer's disease [52]. Pollutants in the form of particles in the air can further worsen neurodegenerative diseases in patients with hypertension [45].

Pollution originating from the air can pose a danger and spread everywhere. Air pollution remains a challenge that must be resolved, especially in urban areas as a source of pollution, especially in low and middle-income countries. Deaths caused by air pollution include cardiovascular disease, bronchial and lung cancer [56]. Air pollution consists of a group of tiny solid or liquid particles floating in the air ($PM_{2.5}$, PM_{10}, $PM_{2.5\text{-}10}$), NO_2 and NO_x, which come from traffic emissions/fossil fuels [53] and ozone (O_3) which can come from air conditioning as well as bacterial decomposition activities in waste and human defecation containers (MCK) [37, 39]. Nitrogen oxide (NOx) compounds can undergo photochemical reactions which react with unburned residual hydrocarbon compounds in car engines to produce peroxyacetyl nitrate (PAN) compounds which can cause eye irritation and respiratory problems. Another impact of air pollution is cognitive decline and dementia [46]; it can also cause inflammation and oxidative stress damage to the brain, which causes neurodegenerative diseases [53].

Air-containing pollution can also cause a decrease in the function of smell, especially with ageing conditions that occur in the elderly [43]. Exposure to air pollution, one of which has an impact on respiratory or nutritional failure, causes neurodegenerative disease of upper and lower motor neurons, which is characterized by a fatal prognosis, namely amyotrophic lateral sclerosis (ALS) [33]. Another fatal impact that causes a higher risk of death from air pollution is lung cancer [41]. This occurs due to a neuroinflammatory reaction and allows the influence of pulmonary inflammation on nerve changes [26].

Given the various explanations regarding the role of air pollution in degenerative diseases, especially neurodegenerative types, there is a growing need for green environments that can offer cleaner air sources. Green spaces play a crucial role in urban areas due to their numerous functions and benefits in enhancing and restoring natural environmental conditions. The demand for green open spaces significantly influences microclimate alterations. A reduction in green open space within a city often leads to increased air temperatures and decreased air humidity. These green spaces, often filled with trees serving as the city's "lungs," play a unique role in continuously producing oxygen. This oxygen production is irreplaceable by other means and is vital for human existence. It is estimated that every hectare of green open space generates approximately 0.6 tonnes of oxygen, providing clean air for up to 1,500 residents daily, allowing them to breathe freely [57]. The need for oxygen in question is the oxygen used by humans and motorized vehicles. To determine the oxygen demand in an urban area, it is necessary to know the number of residents there. Oxygen requirements for humans can be calculated by assuming that humans oxidize 3,000 calories per day from food, use around 600 litres of oxygen and produce around 480 litres of CO_2. Carbon dioxide gas (CO_2) can survive without decomposing in the stratosphere for up to 200 years so that the CO_2 gas pile can become a "greenhouse" that is, it can absorb ultraviolet light from the sun through vibrational, rotational and translational movements of CO_2 compounds and distribute it to the earth's surface and without letting it escape from the stratosphere so that the earth's surface temperature rises to extremes which cause global warming and its various implications for the environment and humanity.

In green spaces, plants are the main component in absorbing carbon dioxide (CO_2) emissions and simultaneously produce oxygen (O_2) through photosynthesis and respiration. Photosynthesis is a biochemical process associated with anabolism, involving the conversion of carbon dioxide and water into glukosa as the primary energy source in the process of glycolysis, the citric acid cycle, as well as electron transport and oxidative phosphorylation, with the assistance of sunlight energy. Chloroplasts are where photosynthesis takes place. Chlorophyll is a green pigment that captures light energy and converts it into chemical energy. The photosynthesis process in chloroplasts goes through two reaction stages: light and dark. The products of the reaction are ATP, NADPH2, and oxygen [57]. Oxygen is released through stomata in the leaf epidermis. The dark reaction takes place in the stroma. In the dark reaction, carbon dioxide (CO_2) is needed. ATP and NADPH produced in photosynthesis trigger the dark reaction (Calvin cycle). In this process, carbon dioxide is bound in the leaves. This carbon dioxide will combine with hydrogen ions produced from the light reaction, forming sugar (glucose). Based on the photosynthesis mechanism, the need for green open spaces can be calculated from the concentration of carbon dioxide (CO_2).

In regions with ample vegetation, daytime air conditions can result in a cooler atmosphere. This occurs because a portion of the sunlight's intensity is blocked by the tree canopy, reducing the influx of light energy that would otherwise heat the air and surface beneath the canopy. Consequently, this helps lower overall intensity and temperature [57]. Light, temperature and vegetation can increase air humidity and reduce wind speed. Vegetation in green open spaces can also control air temperature with the ability to carry out evapotranspiration activities; vegetation can reduce urban air temperature levels [13]. On a broader scale, green spaces play a significant role in addressing the issue of heat islands, characterized by higher air temperatures in urban centres compared to their surrounding areas. The presence of vegetation contributes to a more comfortable environment, offering aesthetic value and the ability to modify climate elements. While these modifications may not lead to drastic climate changes, even small adjustments can have a substantial impact on society. Vegetation within green open spaces engages in photosynthetic activity, specifically the metabolic process of absorbing CO_2 gas, resulting in the production of oxygen [9]. As a result, green open spaces fulfil the requirement for oxygen, sequester CO_2 through the photosynthesis process, and augment the provision of oxygen for the community. This significantly enhances the comfort of individuals within an area, particularly considering the ongoing need for ample oxygen in the presence of various activities and significant vehicular traffic.

Climate change is an issue that is being intensively discussed in all parts of the world [58]. Government efforts to reduce the negative impacts of climate change can start by creating green space management, which has the ecological function of reducing air pollution and regulating the microclimate. Green space management can increase oxygen production and air pollution, which has the potential for thermal pollution and forming heat islands due to heat emissions reflected from the earth's surface into the atmosphere [4, 9, 15]. Green spaces also contribute to the comfort and prosperity of individuals within an area by functioning as the city's lungs. They serve as sources of groundwater, aid in erosion prevention, enhance aesthetics, support ecological life, and provide microclimate control.

Based on the review of pollutants and their impact on health and the environment, the urban green space solutions above are briefly summarized in Table 3 below.

Table 3. Relationship between pollutants, impacts on health and the environment, and urban green space solutions

Author	Journal	Pollutant	Impact on Health and the Environment	Urban Green Space Solutions
Liputo et al. [4]	Environmental International, Elsevier	Hydrocarbons (HC), CO, NO_2, SO_2, PM_{10}, TSP	Respiratory tract infections, eye irritation, asthma, heart and lung disease.	Urban green space is caused by leaves and microorganisms in the soil that can absorb gases concentrated in the air, which become air pollutants.
Darimi et al. [18]	Journal of Environmental Pollution and Management	CO, CO_2, NO_2, SO_2	NO_2 causes respiratory tract infections. CO causes hypoxia in body cells due to lack of oxygen supply. CO_2 causes global warming. CO_2 and SO_2 can also cause acid rain.	Implementation of law no.32 of 2009 concerning environmental protection.
Kim et al. [15]	MDPI Sustainability	PM_{10}, $PM_{2.5}$	Lung disease	Urban green spaces are caused by leaves releasing important substances from their pores to reduce pollutants.
Fitriani et al. [13]	Journal of Urban and Environmental Engineering	PM_{10}, NO_2, O_3	The phenomenon of extreme heat in urban areas.	Urban green space is caused by leaves and microorganisms in the soil that can absorb gases concentrated in the air, which become air pollutants.
Kusuma et al. [57]	Journal of Ecological Engineering	CO_2	The greenhouse effect causes global warming and has various implications for the environment and humanity.	Urban green space provides trees to carry out photosynthesis by converting CO_2, which causes global warming, into O_2 gas, which is very important for the respiration of living things.

Seo et al. [8]	Environmental International, ELSEVIER	Air pollution	Cardiovascular disease	Urban green spaces provide fresh air, which triggers increased human physical activity, which has an impact on heart health.
Richardson et al. [7]	Public Health, ELSEVIER	Air pollution	Cardiovascular disease and mental health.	Urban green spaces provide fresh air, which triggers increased human physical activity, which has an impact on heart health.

The next factor contributing to the increase in degenerative diseases is heavy metals and chemicals from radical compounds and organic solvents. The accumulation of radicals causes cell damage, resulting in degenerative diseases, and radical compounds can originate from chemicals, pollutants, or ultraviolet (UV) irradiation [35, 59]. Other research proves that pollutants increase the inherent impact of exposure to the COVID-19 virus, such as the occurrence of olfactory dysfunction, one of the causes of which is exposure to chemicals [23]. Exposure to heavy metal pollutants such as lead, methylmercury, arsenic, polychlorinated biphenyls, toluene and air pollution can have an impact on decreasing cognitive function in the form of mental health. Mental health can also result, for example, from emotional and physical abuse and neglect, poverty, malnutrition, insensitive parenting or harsh discipline [24].

One of the heavy metals that causes neurodegenerative diseases is mercury. The neurodegenerative process triggered by Hg in the cerebellum leads to deficits in motor function, which is associated with several molecular features in people exposed to mercury poisoning [22]. Mercury compounds can also cause some damage to the Central Nervous System in the spinal cord, an important pathway for communication between the CNS and the periphery, namely in the form of $HgCl_2$ compounds [21]. Another heavy metal that needs attention to be minimized is cadmium, which is usually inhaled as airborne particles near industrial sites or from cigarette smoke [60]. Other pollutants that also have the potential to cause neurodegenerative diseases are pollution of water bodies, such as the presence of organophosphate compounds and polychlorinated biphenyls [38] or the compound benzo[a]pyrene (B[a]P), which is a class of polycyclic aromatic hydrocarbon (PAH) compounds [30]. The increasing load of anthropogenic organic pollutants on water bodies and their great impact on aquatic life lead to strong neurodegenerative diseases (Figure 3).

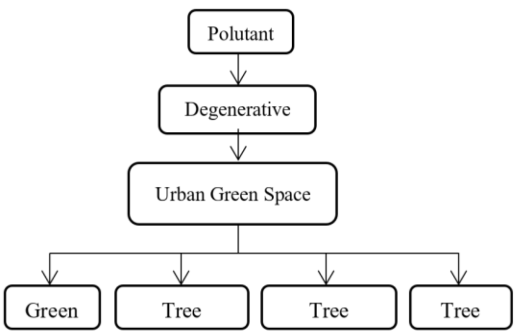

Figure 3. Urban green space solutions for dealing with pollutants and degenerative diseases

Some pollutants include total suspended material (TSP), tiny particles in liquid or solid form that float in the air such as $PM_{2.5}$ and PM_{10}, several heavy metals, especially Pb and Hg, as well as several gaseous compounds such as CO, CO_2, O_3, SO_2, NO_x can cause degenerative diseases, especially cardiovascular and neurodegenerative. The solution to overcoming air pollution and its effects in the form of degenerative diseases is urban green space. Urban green spaces include city parks, trees for pedestrians, as well as all other green areas and lanes. Therefore, urban green spaces must pay attention to the even distribution of trees, closely spaced trees, and a variety of trees that vary according to their respective functions.

Degenerative diseases can be mitigated through the adoption of a healthy lifestyle. Health is a crucial component of the quality of life, contributing to national development efforts aimed at fostering a population of fully healthy individuals in Indonesia. Sports and physical activity are essential components of a healthy lifestyle, serving as a fundamental requirement in daily life by enhancing fitness, which, in turn, aids in fulfilling one's responsibilities. In the pursuit of building a healthy city and fostering healthy citizens, it is crucial to develop the city's "lungs" through green open spaces. These spaces provide residents with freely accessible areas for exercise, play, and recreation, contributing to the overall well-being of the community.

4. CONCLUSIONS

Based on our review analysis, there is a link between pollutants and degenerative diseases, especially cardiovascular and neurodegenerative diseases. However, this still needs to be studied in more depth biochemically and genetically. Urban green space solutions must pay attention to city planning, including the size of green areas, tree types, and tree distribution and density. Urban green spaces can reduce the impact of global warming due to the buildup of CO_2 gas in the stratosphere through photosynthesis. Urban green spaces provide certain chemical substances released through the pores of leaves and microorganisms in the soil to absorb air pollutant gases such as hydrocarbons, CO, O_3, SO_2, NO_x, TSP, $PM_{2.5}$, PM_{10}, which can cause health problems such as respiratory tract infections, lung and heart disease and others.

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