# IMPACT OF INDOOR PLANTS ON HUMAN HEALTH: A REVIEW


## ABSTRACT

One of the goals of a construction was to have a sustainable and healthy interior, something that engineers took seriously when creating and utilizing it. Physical approaches can be used to design arrangements, such as in the layout arrangements, lighting, and air reflections. Still, there has been a fierce pushback against the natural approach paradigm. This paper addresses the greening of interior spaces as a means of preserving and improving the quality of interior spaces. The sick-structure pattern, disinclinations, nasal and ocular vexations, and respiratory dysfunction, including unseasonable fatalities, have all been linked to poor IAQ. The use of phytoremediation is a novel method to lessen air adulterants and improve IAQ by absorbing, adsorbing, assimilating, or transferring them. Thus, the current review's goal is to investigate the role that inner sources play in perfecting inner air quality, including their sanctification capabilities. There's adding substantiation that colorful factory species or their corridor can reliably reduce the attention of multitudinous air adulterants in the inner medium and promote mortal good. still, the inner air adulterant junking effectiveness depends on the species of the factory, and colorful factory characteristics like splint size, consistency, area, photosynthetic exertion, and light intensity. One of the cheapest and most reliable ways to create a healthier inner terrain is by using inner shops. If more focus is put on developing a biophilic environment and increasing the usage of inner stores, more public health can be maintained at a lower cost and with less load on the health care system. As of yet, no standards have been set for fashionable interior stores or how they affect vibrant elements like internal ventilation, moisture content, and temperature. Thus, further experimental exploration is demanded that simulates the interior terrain to cover the impacts of inner shops on factors like moisture, temperature, and ventilation., in perfecting the medium of unrestricted space.



**Keywords:** IAQ, Phytoremediation, Light intensity, Interior ventilation, Temperature, Respiratory disfunction.




## INTRODUCTION:

Houseplants Reduce Harmful Indoor Air Pollutants particle board furniture, paints and plenty of cleansing substances have VOCs, additionally called unstable natural compounds, which

might be chemical compounds that might be launched as gases from not unusual place family products. VOCs, which include benzene, formaldehyde, and trichloroethylene, could have poor fitness outcomes which include an accelerated chance of developing some malignancies, allergies and other respiratory conditions, migraines, CNS damage, and more. Houseplants are a practical and affordable solution to minimize volatile organic compounds (VOCs) and improve the health of your home, even if placing air purifiers and windows can also improve indoor air quality and minimize chemical emissions. **(Chang, T *et al.*,2019)**. An estimated fifteen to eighteen houseplants are required to considerably reduce volatile organic compounds (VOCs) in a residence, as per a study on the subject[55-56]. Another analysis found that dracaena can remove 94% of airborne acetone in a comparable period as bromeliads, which can remove over 80% of typical volatile organic compounds from the air in just twelve hours. All plants can purify indoor air, although some are more effective than others at doing so. The majority of people are aware of how effective connecting with the herbal world is at relieving stress. **(Hunter, P. 2020)**. Working with houseplants has been shown in a study to significantly reduce signs of stress and abnormal places, including elevated cortisol levels, blood pressure, and pulse rates. Repotting indoor plants or watering them might be easy ways to reduce mental chatter and slow down breathing rates. For those who are unable to access the outdoors or the natural world, placing a houseplant on a sunny windowsill can help calm anxious minds and promote relaxation. **(Kaewrat J. *et al.*,2021**). Although vivid flowers and lush greenery can bring charm and coziness to bedrooms, the oxygen-boosting properties of plants can also aid in encouraging sound sleep. Through the process of photosynthesis, plants absorb carbon dioxide and convert it to oxygen, which is then released into the surrounding environment. Recent research suggests that exposure to high oxygen levels at night can promote deeper, more restorative sleep, which is why many doctors and scientists recommend having houseplants in your bedroom. Taking care of houseplants has been shown to help reduce stress's symptoms and signs, but it can also improve your mood by reducing the signs and symptoms of chronic conditions including PTSD, depression, and anxiety. Keeping good care of indoor plants can be "definitely distracting" and help generate a sense of cause, but the benefits of indoor plants on brain fitness go much farther. According to a 2007 study, serotonin is released when certain bacteria, called Mycobacterium vacate, are present in both indoor and outdoor soil. This process enhances both mental and emotional well-being.



## MATERIAL AND METHODOLOGY:

1. **The primary benefits of indoor plants for human comfort and health.** An extensive overview of the impact of indoor plants on human comfort and health based on the following four criteria: transpiration, cleansing, psychological consequences, and photosynthesis **(Amoatey P *et al.*,2020**). The basic processes that keep the carbon and oxygen cycles in nature intact in plants are photosynthesis and transpiration. They could serve as inspiration for human endeavours that are frequently disregarded. **( Carslaw N *et al.*,2019)**. Furthermore, it has been demonstrated that indoor vegetation indirectly influences stress levels, health, and task performance through subconscious mental processes. Indoor vegetation has been extensively explored for its potential to reduce indoor pollution and minimize human exposure. It can function as an effective indoor air cleaner. **( Archary P *et al.*,2022)**. Indoor vegetation has roles in a variety of domains, including sensing, solar energy, acoustics, and human comfort and fitness. Utilizing all of a plant's properties improves human comfort and health (**Toyoda M *et al.*,2020).**

2. **Indoor Plants Effect on Self-Reported Perceptions.** Indoor flora influences how one views oneself. In particular, indoor plants have the power to increase positive emotions, lessen negative emotions, and ease physical discomfort to greatly improve mental perceptions. It is advised to expose people to several flower or foliage pots, each with a small or mild length, at distances of no more than three meters for about twenty minutes. The beneficial effects of indoor vegetation provide sensible guidelines for policymakers, environmental planners, and the general population. **(Moslehian *et al.*,2023)**. Because human beings nowadays spend the maximum of their time interior and are confronted with an increasing number of excessive bodily and mental fitness and health problems, using indoor flora to offer bodily and intellectual fitness blessings merits extra attention **( Berger J *et al.*,2022**) This isn't always best dependent on public fitness but additionally on economic, societal, and environmental sustainability.

3. **Interaction with indoor vegetation may also lessen mental and physiological strain by suppressing autonomic frightened gadget hobbies in younger adults**. Compared to mental labour, this study indicates that engaging in physical engagement with indoor plants can lessen physiological and psychological stress.

**(Hassan *et al.*, 2020)** This is achieved by lowering diastolic blood pressure and sympathetic nervous system activity while fostering calm, at ease, and organic emotions**. (Goldstein *et al.*, 2020)**

4. **A scoping overview of epidemiological research on indoor plant life and intellectual health.** Most studies were conducted in past years during the COVID-19 pandemic. Despite the numerous publicity metrics and intellectual fitness outcomes, all protected research had been aligned to the concept that indoor vegetation may want to advantage intellectual fitness with the aid of lowering stress, depressive symptoms, and terrible emotions, this demonstrated the small sample size and high degree of variation found in epidemiological studies on indoor plants and mental health. **(Pérez-Urrestarazu L *et al.*,2021).** While many studies have demonstrated the beneficial effects of indoor plants, there is limited epidemiological evidence linking indoor plants to improvements in mental health, including decreased stress, depressive symptoms, and negative emotions. This evidence is primarily related to the COVID-19 pandemic. (**Du W. & Wang, G. 2020**) .

5. **Effect of indoor flora in paintings surroundings on intellectual stress.** The presence of vegetation precipitated a massive extrude in mind activity, relative to that determined inside the absence of vegetation**. (Thatcher *et al.*, 2020)**. According to EEG data, having indoor plants increased both the high alpha and high beta activities in comparison to when there were no indoor plants, which had a beneficial effect on mental stress. The higher levels of alpha waves in our study were suggestive of higher degrees of relaxation when working with indoor plants **( Cetin M *et al.*,2023).**

6. **Feasibility have a look at intellectual health-care results of plant installations in workplace spaces.** The impacts of plant installations in office spaces on mental health care include the relaxing of visible weariness and the emotions of drowsiness of organizations of work-associated fatigue emotions. The type of plant and industry having an impact on these effects are the determining factors. **( Cocârţă D *et al.*,2021).**

7. **An assessment of indoor inexperienced flowers was conducted to enhance the indoor environment.** Effects of indoor pollutants, such as CO2 concentration and volatile organic compounds (VOCs), on the interior thermal environment, Although the effectiveness of using green plants was discussed in terms of learning or production, patients' overall post-operative recovery and emotional state **( Jung, C., & Awad, J. 2021).**

8. **Improving the IAQ for Learning Efficiency with Indoor Plants.** The total amount of CO2 breathed out exceeded the legal limit of 1000 parts per million, yet the participants were unaware of the elevated levels of CO2 indoors**. (Tsai, W. T. 2019).** It is analytically demonstrated that maintaining the indoor plant leaf area density at roughly 14.68% of the floor area might reduce the CO2 concentration by respiration by 50%. **( Li C *et al*.,2021**). When it comes to the positioning of plants, people believe that indoor air is 40% crispier and 140% more palatable. Additionally, there was a 108% improvement in the complaints of SBS symptoms and a roughly 120% improvement in the ability to concentrate on studying. The placement of indoor plants will rise as people become more conscious of sustainability. (**Jung C *et al*.,2021).** Indoor plants today not only filter indoor air but also provide a visible green effect to improve human comfort.

9. **The look of indoor flora and their impact on people's perceptions of indoor air high-satisfactory and subjective well-being.** The plant's outward look significantly influenced the participants' responses, aesthetic preferences, and perceptions of the plant's benefits for humidity, indoor air quality, and subjective well-being. The physical characteristics of the plant can be utilized to forecast how people would perceive its effects on SWB and IAQ ( **Berger J *et al*.,2022**). The terms "beautiful," "interesting," "uplifting," and "relaxing" were shown to be the most reliable indicators of benefits for SWB. With the largest SWB benefit, the most suggested plants are Ficus sphere, palm, Ficus column, and Epipremnum. To optimize the health benefits for building inhabitants, designers and installers had to select wholesome indoor plants that people find appealing and captivating **(Ramya A. *et al*.,2021).**

10. **An assessment of common indoor plants' ability to enhance studio apartment indoor air quality.** Ventilation plus a biofilter can lower CO2, TVOCs, HCHO, PM2.5, and PM10 levels by 76%, 87%, 75%, 52%, and 51%, respectively. concluded that a variety of indoor potted plants offer a sustainable, cost-efficient, self-regulating, and effective way to improve indoor air quality and, in turn, people's health and productivity in small, confined spaces **( Maung T *et al.*,2021).**

11. **Utilizing indoor plants as a substitute tactic to enhance indoor air quality.** Reduced air quality below the established threshold is indicative of indoor air pollution. The quality of indoor air is determined by the ambient air quality as well as by a toxic material produced by home activities. **(Ali *et al.*,2021)** In addition to causing lung cancer, asthma, chronic obstructive pulmonary disease (COPD), and sick-building syndrome, indoor air pollution is also linked to over two million deaths in developing nations. (**Balmes *et al.*,2019**). The use of indoor plants is one of the fascinating research topics to address the issue of indoor air pollution. Despite the lack of established guidelines for the best indoor plant, a number of research have identified the ability of a certain indoor plant to remove harmful compounds. **(Luo *et al.*, 2021).** This gives evidence-based insight into the utility of indoor plants as a substitute for indoor air remediation and contains key information concerning indoor air pollution. **(Sharma *et al.*,2019)**.

12. **Using tobacco smoke to help detect harmful metals by using indoor flora as bio monitors.** Houseplants and biomonitoring agents include Dieffenbachia amoena, Dracena marginata, Ficus elastica, Spathiphyllum wallisii, and Yucca massengena. A small amount of toxic metal accumulation can be easily seen in houseplants. Lead (Pb), cadmium (Cd), and chromium (Cr) were chosen due to significant emissions from cigarette smoke. They ascertained this by utilizing inductively coupled plasma-optical emission spectrometry (ICP-OES) to analyse the plant species' leaves. In all species, tobacco use was associated with greater amounts of Cd, Cr, and Pb (Pb > Cr > Cd) than non-tobacco use. **( Ghoma *et al.*,2022** ).

13. **Human Relations, Indoor Air Pollution, and Current Trends in the Management and Enhancement of Indoor Air Quality.** An analysis and assessment of the main causes of significant pollutant emissions, fitness consequences, and issues related to illnesses predominantly based on IAP, including sick building syndrome (SBS) and building-related illness (BRI) **(Yang D *et al.*,2023)**. Furthermore, the methods and strategies for controlling and undervaluing pollutant concentrations are highlighted, along with the most recent advancements in attempts to address and enhance IAQ and their associated benefits and potentials. (**Pichlhöfer A *et al.*,2021).** The development of new materials for sensors, IAQ monitoring systems, and smart homes is anticipated to be a viable strategy for IAQ manipulation and improvement in the future**. (Tran V *et al.*,2020).**



**TABLE 1. ENVIRONMENTAL FACTORS AFFECTING INDOOR AIR QUALITY**

| Sr. No. | Environmental factors | Recommended species | References |
|---|---|---|---|
| 1 | Indoor Air Quality (IAQ) | Golden pothos, Sword fern , English ivy , Dracaena , Lady palm | Fraser Torpy, Michael Zavattaro [2018] |
| 2 | Carbon Emission (CO2) | Snake plant , Spider plant, Jade plant , Money plant , Areca palm | Mehmet Cetin, Hakan Sevik [2016] |
| 3 | Particulate Matter (PM) | Rubber plant , Aloe vera, Chinese evergreen | Stapleton, E.; Ruiz-Rudolph, [2018] Fraser Torpy, Michael Zavattaro [2018] |

| | | | |
|---|---|---|---|
| | | Philodendron, Fittonia | |
| 4 | Voletile Organic Compound (VOC) | Areca palm , Bmboo palm , Rubber plants , Peace lily , Dracena | Yu Gong et al (2019) |

**TABLE 2. HEALTH COMPONENTS AFFECTED BY INDOOR PLANTS**

| **Sr. No.** | **HEALTH FACTORS** | **Recommended species** | **References** |
|---|---|---|---|
| 1 | Mental Stress | Peace lily , Snake plant , Common ivy , Money plant , Jade plant | Han, K.-T. (2018) |
| 2 | Respiratory Disease | Spider plant , Areca palm , Pothos , Aloe vera , Rubber plant | Ahu Aydogan, Ryan Cerone [2021] |
| 3 | Lung Cancer | Spider plant , Snake plant , Areca palm , Pothos , Aloe vera | Vuokko, A., Selinheimo, S., Sainio, M., Suojalehto, Virtanen, M & Karvala, K. (2015). |

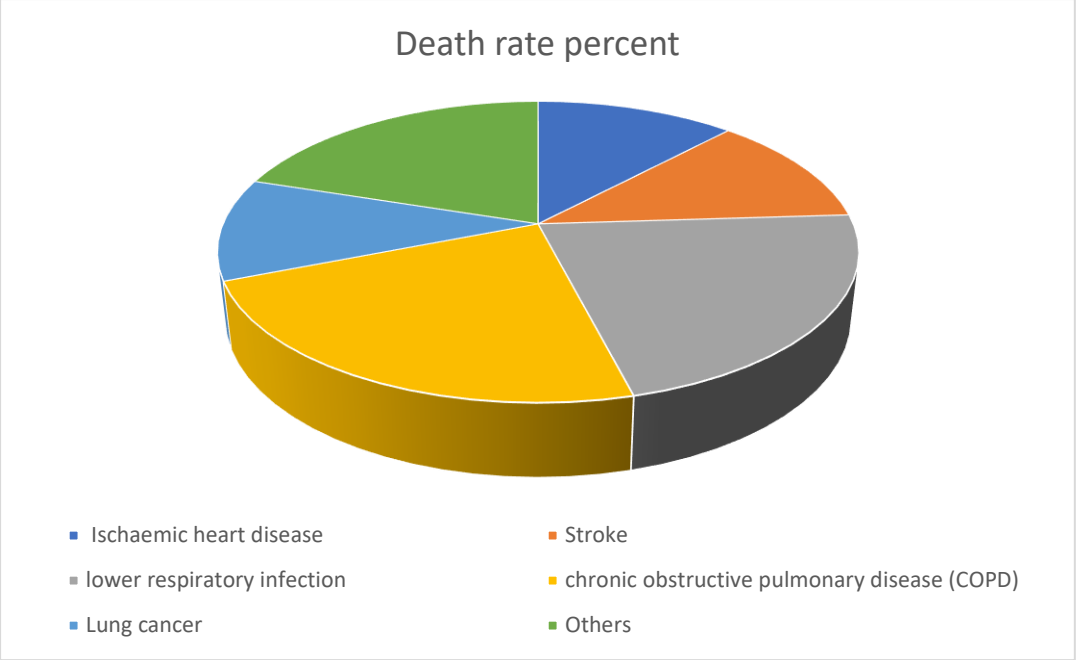


FIGURE 1: Death rate due to Indoor Air Pollution ( WHO, 2023)



**TABLE 3. AESTHETIC COMPONENTS IN INDOOR ENVIRONMENT**

| Sr. No. | AESTHETIC COMPONENTS | Recommended species | References |
|---|---|---|---|
| 1 | Terrariums | Air plant , Sword fern , Polka dot plant , Dracaena , Fittonia | Dr. Imad M. Assali, [2017] |
| 2 | Vertical Frames | Money plant, Philodendron, Aglonema, Begonia, Dracena | Raji, B., & van den Dobbelsteen, A. (2015) |
| 3 | Dish gardens | Devil's ivy , Jade plant , Lucky bamboo , Begonia , Peace lily | Nejati, A., Shepley, Lee, C., Varni, J. (2016) |

**TABLE 4. PLANT RECOMMENDED FOR INDOOR ENVIRONMENT**

| Sr.No. | BOTANICAL NAME | COMMON NAME |
|---|---|---|
| 1 | *Epipremnum aureum* | Money plant |
| 2 | *Dracaena fragrans* | Dracaena |
| 3 | *Dracaena trifasciata* | Snake plant |
| 4 | *Sansevieria trifasciata* | Sansevieria |
| 5 | *Syngonium podophyllum* | Syngonium |
| 6 | *Bambusa vulgaris* | Bamboo plant |
| 7 | *Aglaonema commutatum* | Aglonema |

FIGURE 2: Photographs of Indoor Plants

**TEMPERATURE AND HUMIDITY REQUIRED FOR INDOOR PLANTS :**

**Temperature:**

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Temperatures that are too high or too low can harm foliage, cause leaf loss, stunt growth, or even kill plants. Maximum indoor plants, however, can withstand frequent temperature changes.

• The majority of indoor flowering plants choose the same variety during the day, but they flourish at night-time temperatures of 55° to 60°F; • A precise rule of thumb is to keep the night-time temperature to 10 to 15°F lower than the daytime temperature to induce physiological recovery from moisture loss, intensify flower color, and prolong flower life; and Indoor plants are sensitive to drafts and heat from registers, especially flowering types. Keep them safe from abrupt temperature changes. Never again find your indoor flowers near sources of heat or air conditioning.

**Humidity:**

Particularly in the winter, most indoor spaces are too dry for healthy indoor plants.

• All indoor plants, except cacti and succulents, benefit from treatments that increase the surrounding humidity.

• There's some debate as to whether spraying plants will boost humidity. If you choose to accomplish this, use tepid water and stop misting plants with fuzzy leaves, such as African violets. Early in the day, mist the leaves to help them dry before dusk.

•One way to increase humidity throughout the space is to set pots on a tray filled with water and rocks.

• When you place plants in a room together, the humidity level in that space will increase.



## 2. LIGHT HOURS REQUIRED FOR INDOOR PLANTS :

• Seedlings: 16 to 18 hours daily.

• Hydroponically grown herbs and lettuce: 12–14 hours daily.

• Houseplants with foliage: 12–14 hours.

• 14–16 hours for houseplants to bloom.

**Bright Light:** A sunny, mildly lit window facing the south or west that receives direct sunlight throughout the day**.** It must get not less than 5 to 6 hours of daylight every day, ideally more. Plant care can now and then be tougher for winters face up to the temptation to transport your plant toward the window. Most flora that wants shiny mild will now no longer be capable of dealing with the bloodless drafts that grow the nearer you pass towards a window. e.g. Snake plant, Spider plant, Aglaonema, Dracaena etc

**Indirect Light:** Indirect mild may be discovered in locations with an east-dealing window, or in an indoors of a room that gets completely mild from a south- or west-dealing window. This can also mean there for instance. e.g. Jade plant, Parlour palm, Sword fern, Devils ivy etc.

**Low Light:** Especially in the winter, a lot of rooms can be considered low light. Low-mild conditions may apply to rooms with north-facing windows or partially shaded residential windows. It's probably poor light if you find it tough to examine a newspaper. With the addition of artificial light, plants can still thrive in low-light environments. For instance. Peace lily, English ivy, philodendron, and golden pathos.

**CONCLUSION :**

One of the main ways that plants help people live longer and in better health is by boosting their immune systems' ability to fight disease. Living in a healthy atmosphere and eating a well-balanced, nutritious diet could help achieve this. Plants were a key detail inside the human surroundings that at once and in a roundabout way enhanced human health. By presenting human beings with oxygen and food, plant extractions were broadly used inside the pharmaceutical enterprise as useful resources in ailment prevention and treatments. While circuitously via way of means of enhancing the surroundings via air-purifying and elimination of air pollutants. Indoor plants such as aloe vera can be used as home remedies to aid in managing various diseases. Also, flora has a mental impact that affects human productivity and destressing which influences humans. Indoor plants have been known to add aesthetic value to their surroundings as well as to home decor. However, indoor plants such as rubber trees, English ivy, and spider plants increase the performance in human psychology. The presence of indoor scented and unscented plants enhances human comfort. It has been demonstrated that plant photosynthesis improves air quality by producing negative ions. In addition to eliminating pollutants and volatile organic materials, plants have also been discovered to control humidity and temperature. In general, having indoor plants improves air quality and has numerous

positive effects on people's physical and mental health. Indoor plants help to affect many environmental factors such as indoor air quality, carbon emission, particulate matter and volatile organic components as well as health factors such as mental stress, respiratory disease, lung cancer etc.

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