

Air Cleaners and Human Health

Prof. Alireza Afshari



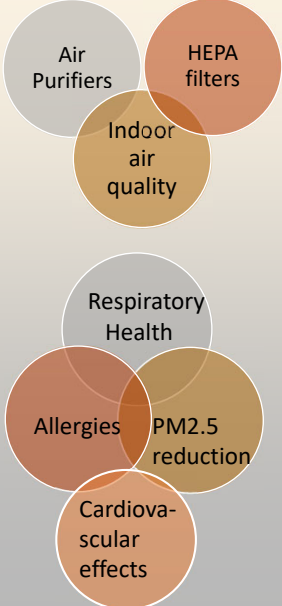
Introduction

The studies, conducted in various settings and contexts, offer a comprehensive perspective on the relationship between air purification and human health.

Investigations on allergen reduction, respiratory health, and even cardiovascular outcomes, these studies are instrumental in providing evidence-based insights into the transformative effects of air cleaners.

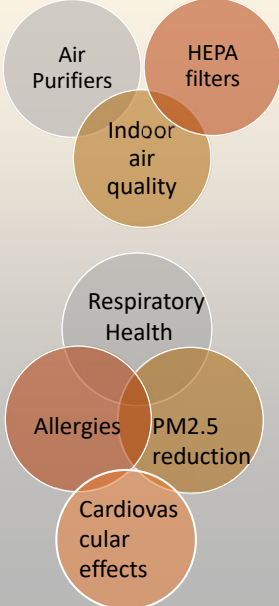
Methodology

Keywords

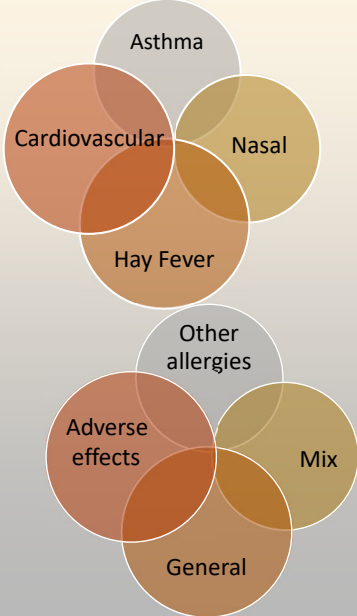


Methodology

Keywords

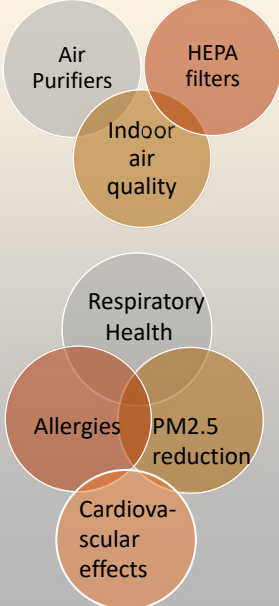


Categories of Articles



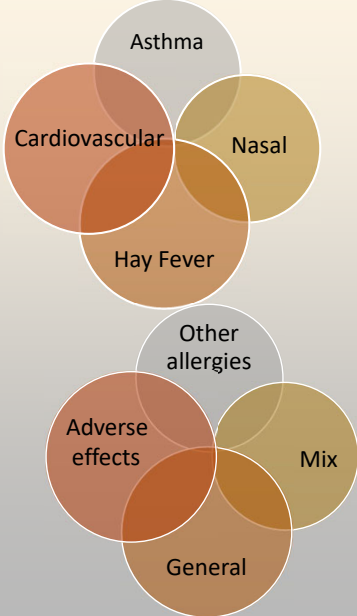
Methodology

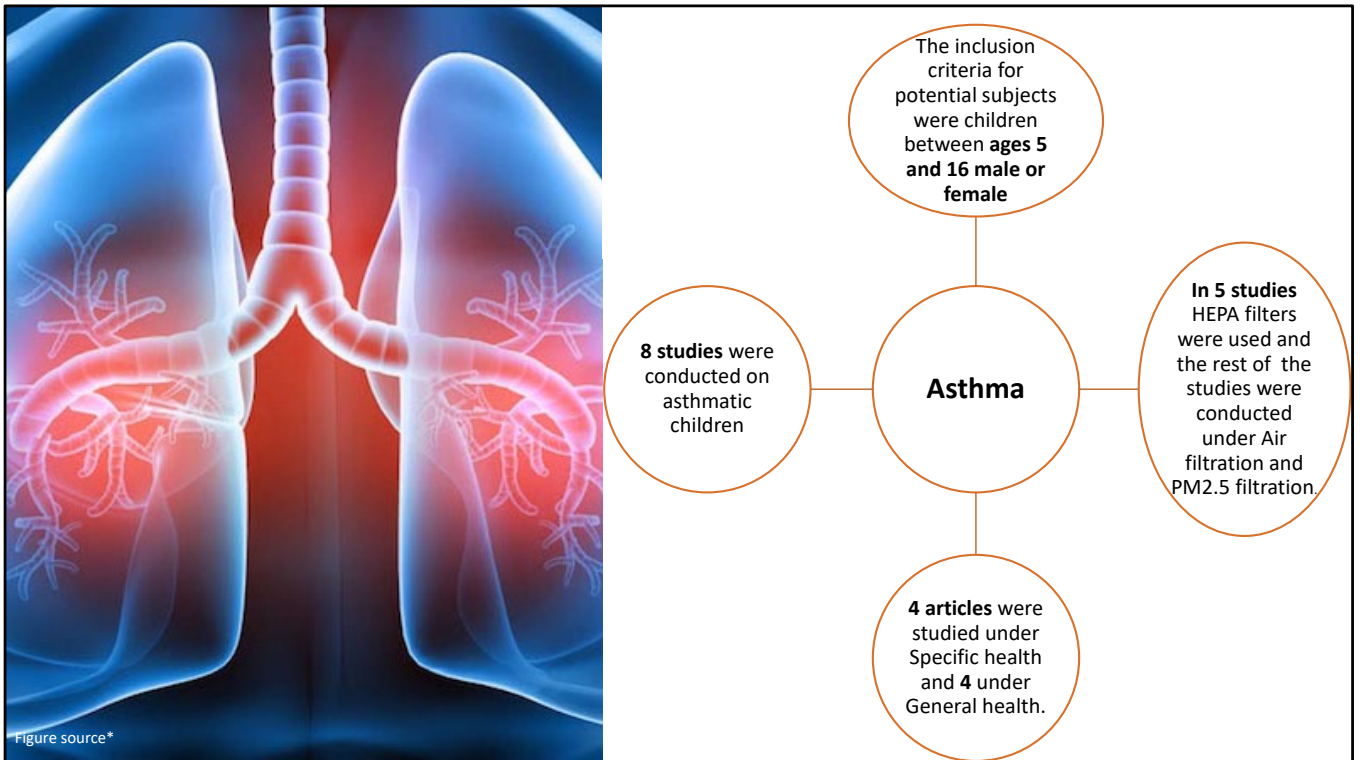
Keywords



Studies were conducted
60 studies were reviewed out of 97 studies from the years 1991-2022

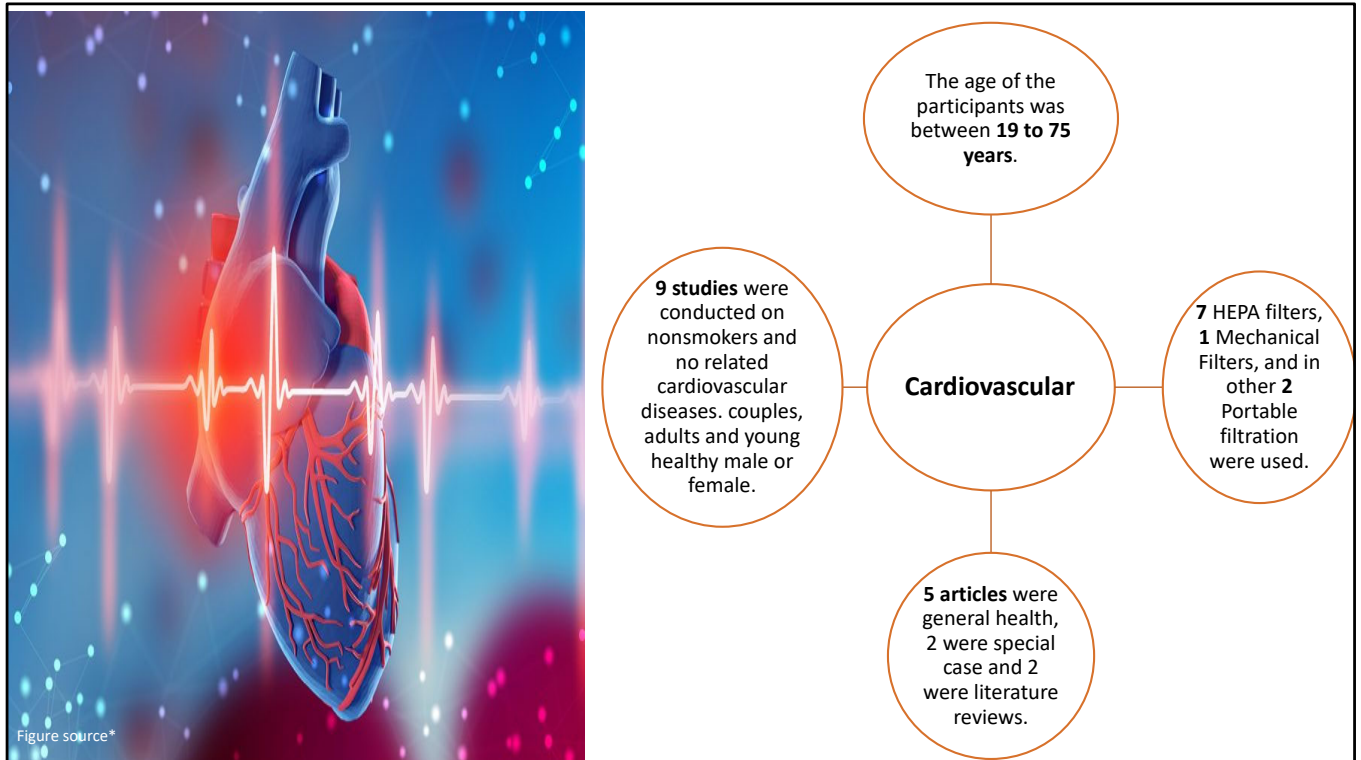
Categories of Articles





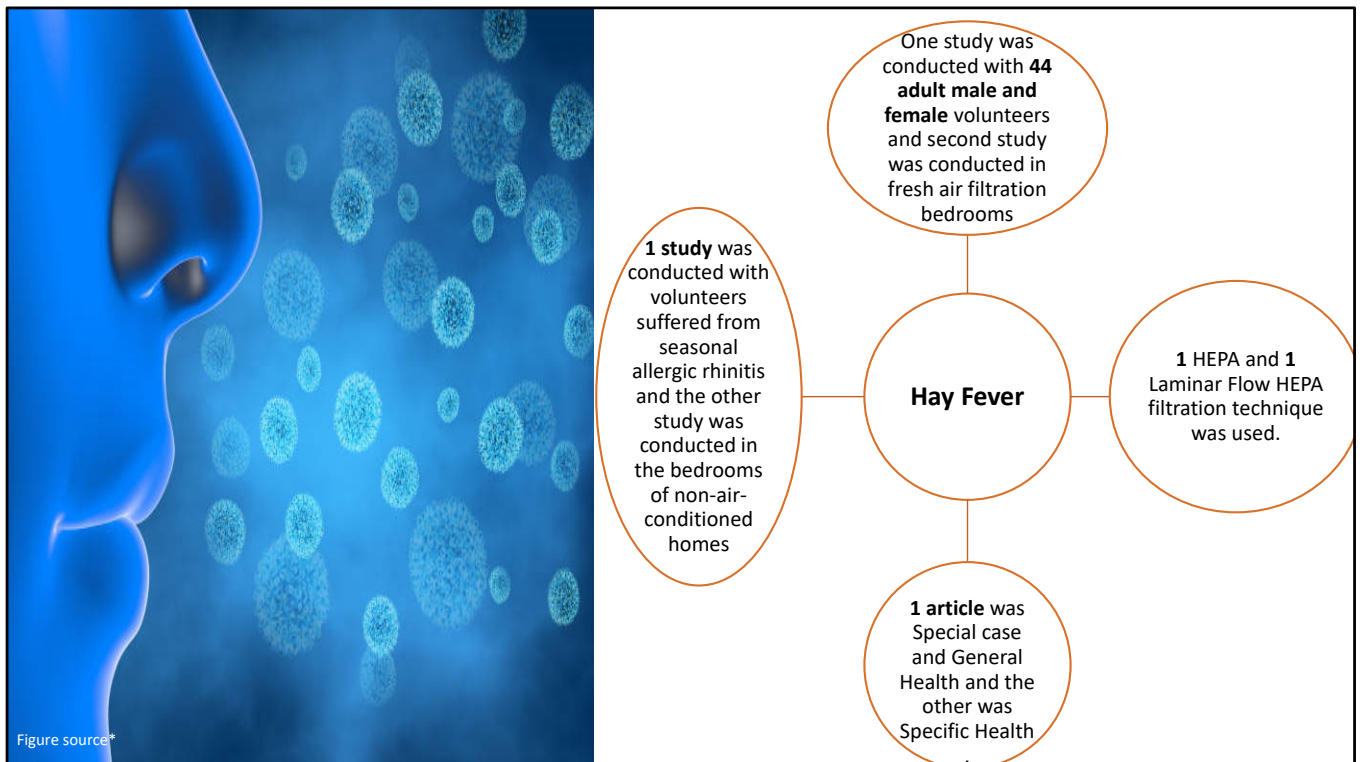
- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://www.metropolisindia.com/blog/preventive-healthcare/everything-about-asthma>



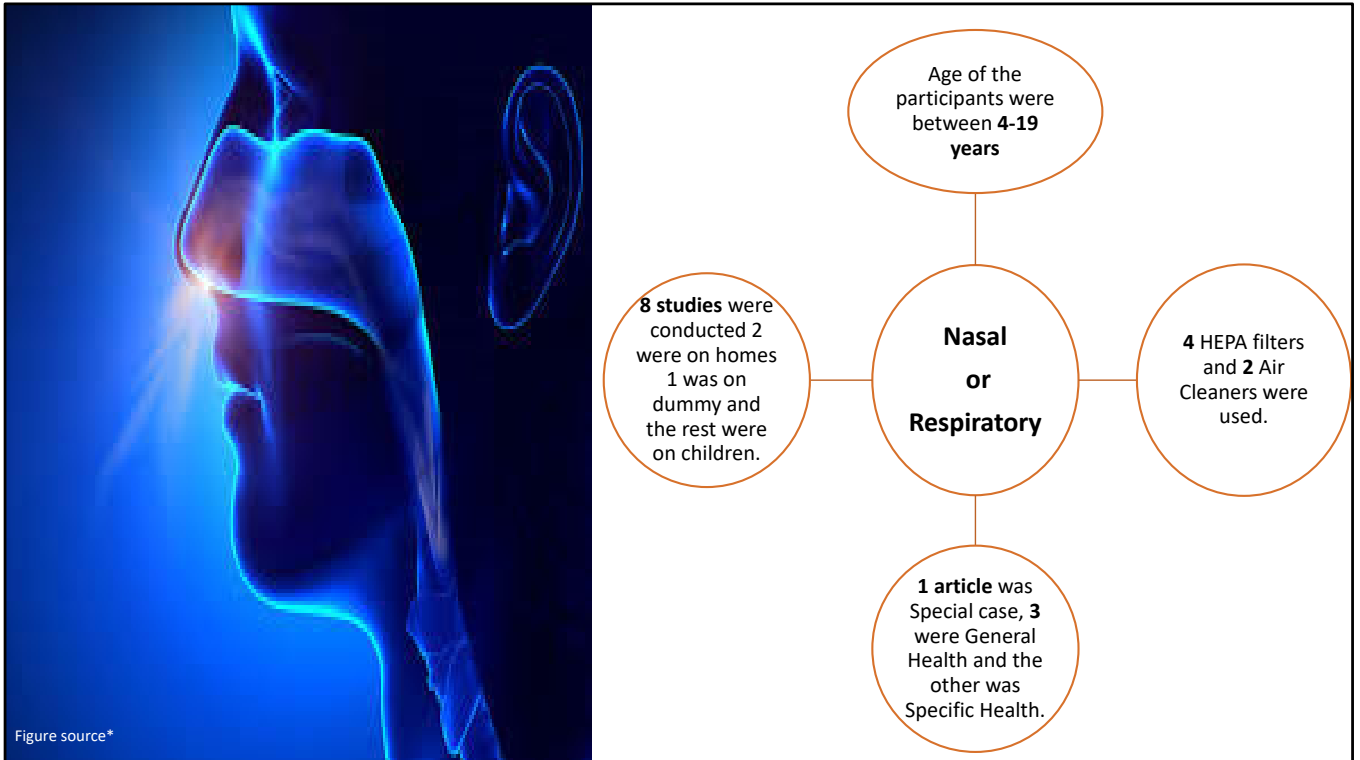
- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://www.merillife.com/blog/in-the-news/top-advances-in-prevention-treatment-of-cardiovascular-disease>



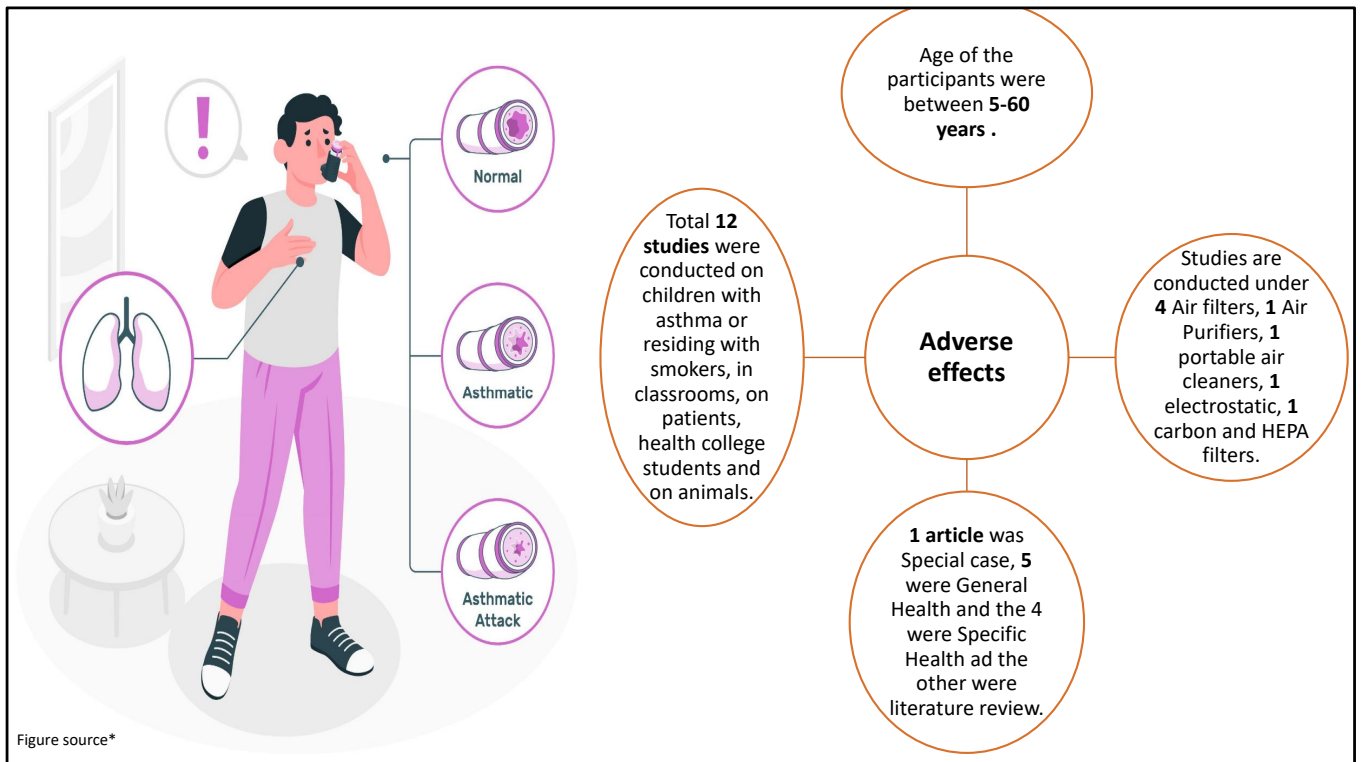
- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://www.istockphoto.com/photos/nasal-allergy>



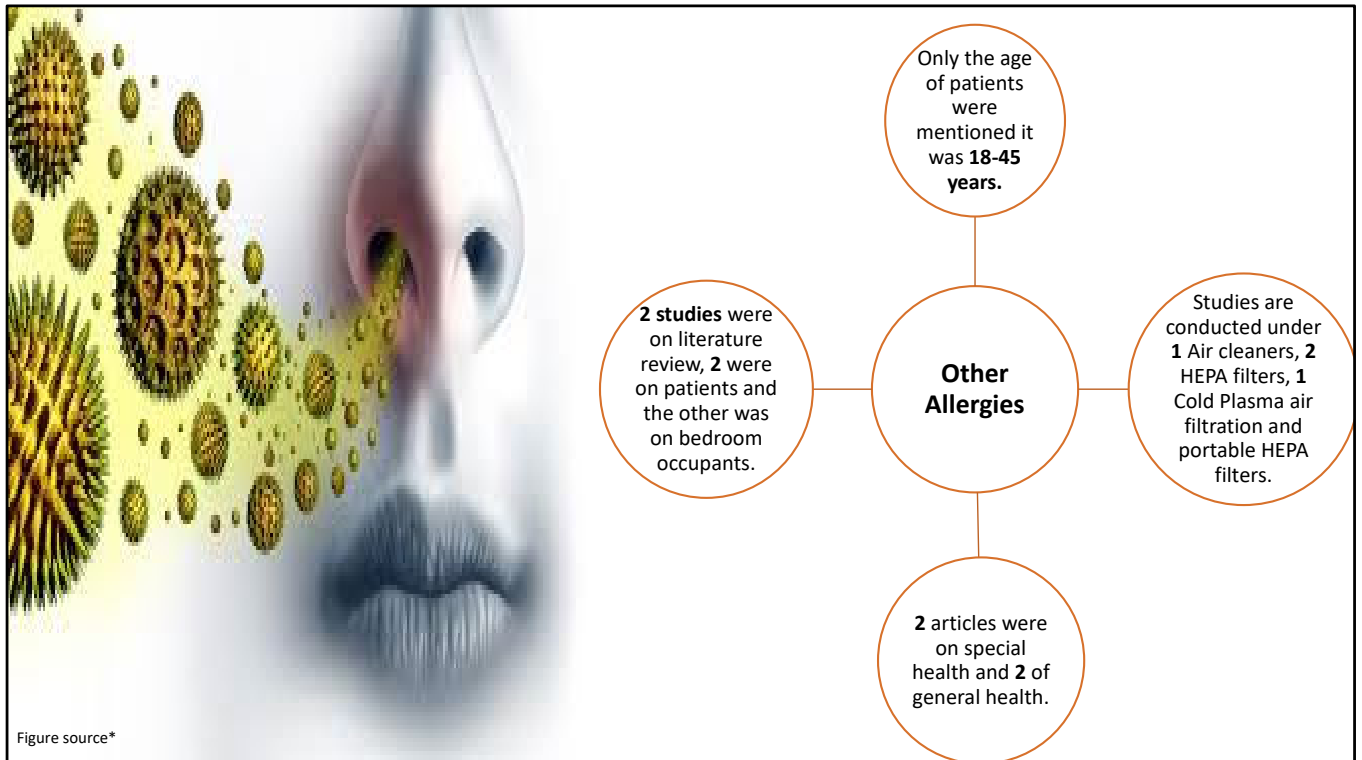
- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://www.istockphoto.com/photos/nasal-allergy>



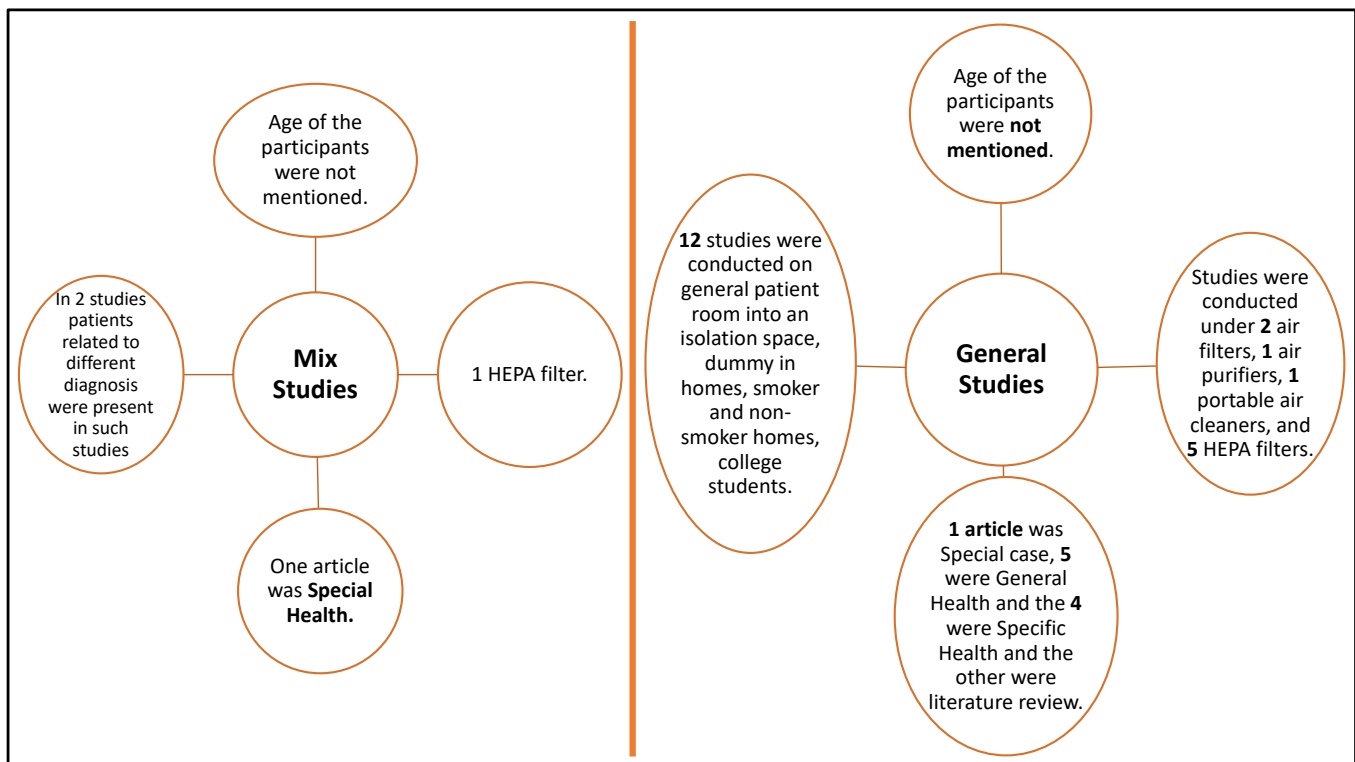
- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://ayu.health/blog/10-asthma-precautions-for-asthma-attack-prevention/>



- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

*<https://www.bergerhenryent.com/why-do-we-get-allergies/>



- Portable air cleaners and air purifiers: The filters used in studies, but the type of technology is not specified.
- Air filters, portable air filters, air cleaners, HEPA filters names are used based on technology identified in the articles.
- Specific Health: The conclusion of the study specified the impact of air cleaners on the specific sickness in an indirect way.
- General health: The overall effectiveness of air cleaners on the specific sickness and human health was shown.
- Special cases: In the special cases, along with portable air filters, the changes were made in the ventilation system of the building to improve sickness/human health

Nasal or Respiratory: Key Findings

Park et al., 2016

- The study provided evidence that the intervention with air purifiers, as seen in Fresno, California, led to improved indoor air quality and health outcomes for children with allergic diseases. These outcomes align with the broader benefits of air purifiers as summarized in the conclusion.

Emmerich & Nabinger, 2011

- The effectiveness of the tested particle air cleaning devices in improving indoor air quality by reducing particle concentrations are demonstrated by comparing the CONTAM model highlights the model's ability to predict the IAQ impact of these devices with a high degree of accuracy.
- The findings supported the potential benefits of using air purifiers, aligning with the conclusions mentioned earlier regarding improved respiratory health.

Huang et al., 1993

- The findings from the study underscore the positive impact of air cleaners on the health and well-being of children with perennial allergic rhinitis.
- The findings closely align with the benefits of air cleaners outlined in conclusion, provided empirical evidence that air purifiers can play a significant role in improving indoor air quality and health for individuals with allergies and asthma.

Nasal or Respiratory: Key Stats

Studies	Statistical Data for Improvement in Sickness
(Dong et al., 2019)	Real purification using ionization air purifiers effectively reduced PM and BC levels by a significant percentage, while increasing negative air ions (NAI). It was associated with a 4.4% increase in forced exhaled volume in 1 s (FEV1) and a 14.7% decrease in fractional exhaled nitrogen oxide (FeNO) .
(Emmerich & Nabinger, 2001)	Results in this study showed some air cleaners used achieving 100% efficiency , suggesting additional particle removal beyond filtration.
(Park et al., 2016); (Yang et al., 2021); (Cox et al., 2018); Peng et al., 2014 and (Huang, 1993)	No Statistical results provided.

PM: particulate matter; BC: black carbon

- The stats above prove that intervention of air cleaners can indirectly lead to substantial improvements in nasal or respiratory system.

Asthma: Key Findings

Van Der Heide et al., 1999

- The study provided empirical evidence for the use of air cleaners in homes of asthmatic children sensitized to pet allergens can lead to significant improvements in respiratory health and overall well-being.
- The improvements in health closely align with the benefits of air cleaners mentioned in conclusion, supporting the idea that air purifiers can play a crucial role in improving indoor air quality and health for individuals with allergies and asthma.

Wu & Takaro, 2007

- The study highlighted the significance of environmental interventions in reducing asthma triggers and improving the health of asthmatic children.

Cui et al., 2020

- The results suggested that PM2.5 filtration devices in bedrooms can lead to improvements in airway mechanics, function, and reduced inflammation in children with asthma.

Asthma: Key Stats

Studies	Statistical Data for Improvement in Sickness
(Du et al., 2011)	When filters were used, average PM concentrations were <u>decreased by 69 to 80%</u> .
(Batterman et al., 2011)	Filters <u>reduced</u> PM levels to 50% in the child's bedroom suffering from asthma.
(Xu et al., 2010)	A significant <u>decrease</u> in (PM) concentrations by an average of 72% and total volatile organic compound (TVOC) concentrations by 59% .
(Crain et al., 2002)	Children with Asthma exposed to allergic environment and environmental tobacco smoke (ETS) resulted in more than 50% of the enrolled children to three or more allergens, even after intervention of air filters.
(Cui et al., 2020)	True filtration resulted in a significant reduction in total airway resistance (24.4% reduction), small airway resistance (43.5% reduction), resonant frequency (22.2% reduction), and an increase in airway reactance (73.1% increase). True filtration also led to significant improvements in fractional exhaled nitric oxide (27.6% reduction) and peak expiratory flow (1.6% increase).
(Sublett et al., 2010)	The literature study showed not statistical relation.
Van Der Heide et al., 1999; (Wu & Takaro, 2007)	No Statistical results provided.

- PM: particulate matter
- Airway resistance: The change in transpulmonary pressure needed to produce a unit flow of gas through the airways of the lung.
- Resonant frequency and airway reactance: Indicators to know the improvements in pulmonary system.

- The above stats prove that intervention of air cleaners can indirectly lead to substantial improvements in asthma by improvements in different concentrations and sickness indicators stated above.

Cardiovascular: Key Findings

Bräuner et al., 2007

- The findings from this study demonstrate the significant impact of reducing indoor particle exposure through air filtration on microvascular function in the elderly. These findings closely align with the benefits of air cleaners mentioned in conclusion, supporting the idea that air purifiers can play a crucial role in improving indoor air quality and contributing to better health, particularly in the context of cardiovascular health in older adults.

Chuang et al., 2017

- The findings from this study suggest that long-term air filtration with air conditioner filters can lead to improved cardiovascular health by reducing exposure to air pollution during experimental research.

Al-Kindi et al., 2020

- The findings from this comprehensive review strongly support the importance of reducing exposure to air pollution, including PM2.5, to protect cardiovascular health among patients of different age groups.

Cardiovascular: Key Stats

Studies	Statistical Data for Improvement in Sickness
(Morishita et al., 2018)	In a study of 40 participants, air filtration significantly reduced personal exposure to PM2.5 and lowered brachial systolic and diastolic blood pressure by 3.2 mm Hg and 1.5 mm Hg , respectively, with more pronounced reductions during low-efficiency filtration.
(Kajbafzadeh et al., 2015)	There was evidence of an association between indoor PM 2.5 and C-reactive protein among those in traffic-impacted locations (42.1% increase in C-reactive protein per IQR increase in indoor PM 2.5 , 95% CI 1.2% to 99.5%), but not among those in woodsmoke-impacted locations.
(Al-Kindi et al., 2020); (Rajagopalan et al., 2020)	These studies were literature reviews that didn't conclude with statistical data.
Bräuner et al., 2008); Chuang et al., 2017; (Lin et al., 2011); (Day et al., 2018)	No statistical results provided.

PM: particulate matter; C-reactive protein: Protein made by the liver; IQR; interquartile range

- The stats above prove that intervention of air cleaners can indirectly lead to substantial improvements in cardiovascular system.

Hay fever: Key Findings

Brehler et al., 2003

- The study's findings strongly support the idea that fresh air filtration systems can provide hay fever relief and improve respiratory health by reducing allergen exposure to the significant extent.

Morris et al., 2006

- The study's findings strongly support the idea that the novel laminar flow air filtration device provides hay fever relief, improves respiratory health, and enhances overall quality of life by reducing allergen exposure.
- The results emphasize the role of air cleaner in improving indoor air quality and contributing to better health, particularly in the context of hay fever relief.

Hay Fever: Key Stats

Studies	Statistical Data for Improvement in Sickness
(Brehler et al., 2003)	Among volunteers suffering only from hay fever, 83.3% of volunteers reported decrease in hay fever after using air fliters. For volunteers suffering from both hay fever and perennial allergy symptoms, 69.2% reported decrease in both allergy symptoms and Hay fever.
(Morris et al., 2006)	77% of the subjects showed significant improvement in symptom scores, with an average improvement of 26% in the morning and 24% in the evening.

Other Allergies: Key Findings

Van der Heide et al., 1997

- The study on allergen reduction measures in houses of allergic asthmatic patients found that air-cleaners, when used in combination with allergen-impermeable mattress covers, can contribute to diminished allergen exposure and improvement of airway hyper responsiveness in asthmatic patients.

Cheng et al., 1998

- The study provides empirical evidence that supports the conclusions related to improved respiratory health, allergen reduction, cardiovascular benefits, hay fever relief, and cleaner indoor air.
- The effectiveness of the air cleaner in reducing airborne allergens underscores its potential to enhance indoor air quality and contribute to better health outcomes.

Myatt et al., 2008

- The study emphasizes the effectiveness of high-efficiency in-duct air cleaners in reducing asthma triggers indoors.
- The air cleaners contribute to cleaner indoor air, benefiting those with allergies and asthma by improving respiratory health and overall quality of life. The study underscores the importance of whole-house solutions over single-room air cleaners.

Other Allergies: Key Stats

Studies	Statistical Data for Improvement in Sickness
(Van Der Heide et al., 1997)	Utilization of both active air-cleaners and mattress covers, showed a statistically significant improvement in airway hyper responsiveness by 20% fall in forced expiratory volume in one second (PC20).
(Cheng et al., 1998)	A HEPA room filter in a 24 h test removed 80–90% of pollen, fungal spores, and particles in a bedroom, as compared to <u>~50% removed due to sedimentation in a comparable control bedroom without a filter.</u>
(Dong et al., 2019)	Intervention of air filters resulted in 30–55% lower allergen levels , 90–99% lower risk of respiratory infection through the inhalation route of exposure, 90–98% lower environmental tobacco smoke (ETS) levels , and 50–75% lower fungal spore levels.
(Reisman, 2001) and (Liu et al., 2017)	No statistical results provided.

- Airway hyperresponsiveness (AHR) is defined as the predisposition of the airways of patients to narrow excessively in response to stimuli that would produce little or no effect in healthy subjects. It is one of the hallmark for asthma patients and correlates with the disease severity.

Adverse Effects: Key Findings

Antoniceilli et al., 1991

- In the context of mite-allergic patients with relatively low allergen exposure, HEPA filter air cleaners alone may not be sufficient substitutes for standard avoidance measures.
- While it didn't provide strong support for improved respiratory health and allergen reduction in this specific scenario, the effectiveness of air cleaners may vary depending on allergen levels.
- The conclusion that air cleaners can contribute to better health still holds, **but** their efficacy may be context-dependent.

Yoda et al., 2020

- The study on the effects of using air purifiers among healthy adults found that while air purification slightly improved indoor PM2.5 concentrations in ordinary homes, it had no demonstrable impact on improving health.
- This finding aligns with the conclusion that air cleaners, in this particular context, did not lead to significant improvements in the respiratory health of healthy adults.

Mattsson & Hygge ,2005

- The study found that using air cleaners during pollen season improved the health and cognitive performance of students sensitive to airborne contaminants like pollen.
- These students experienced less irritation in their airways and performed better in tests related to semantic memory when the air cleaners were active. However, there were no significant effects on other cognitive skills.
- This supports the idea that air cleaners can benefit individuals with allergies and sensitivities, contributing to better respiratory health and well-being

Overall Conclusions

Air cleaners, specifically air filtration and purification systems, play a significant role in improving human health outcomes in indoor environments, particularly for individuals with allergies, respiratory conditions, and the elderly.

