

## **The relationship between breast cancer and air pollution: Review article**

### **ABSTRACT**

Air pollution composed of compound of substances resulting from many human and natural resources, which can cause mutations. Almost proven that air pollution contributes to lung cancer, and its relationship with other cancers, including bladder, cervical cancer, ovary, prostate, brain and breast suspect. Breast cancer is the most frequent cancer in women and prominent cause of death among them in all around the world. Poor prediction of personal risk factor leads to search for more factors. Mammary tumors in animals which has generated by compounds, give possible mechanisms for effects of environmental pollutants. Therefore, the purpose of our study is to review the available literature for investigating the relation of ambient air pollution and breast cancer. Findings of our study highlight the possibility of increasing in occurrence of breast cancer, developing to invasive cancer and mortality in both premenopausal and postmenopausal women by being subjected to air pollution.

**Keywords:** Air Pollution, Breast Cancer, Risk factor

### **Introduction**

It has been a long time that we know urban air is polluted which has gaseous and solid particles, and long or short exposure to them lead to disease and mortality (1). Many of these solid or gas compounds are mutagenic and carcinogenic substances and causing mutations which can lead to cancer (1). Several studies considered Being exposed to air pollution as a factor associated with breast cancer (2, 3). Almost proven that air pollution contributes to lung cancer, but its relationship with other cancers including bladder, cervical cancer, ovary, prostate, brain and breast suspect(4). By increasing our knowledge about the result of air pollutants on public health is necessary for the advancement of practical policies to lessen the negative effect of air pollution (5). In this study, we briefly reviewed the relationship between breast cancer and air pollution.

### **Air pollution:**

Pollution in the air composed of compounds substances that resulting from many human and natural resources. In many parts of the universe, cooking, transportation, interior heating, industry, power generation and biomass burning are dominant human resources(6). Some countries have settled control system that record the degree of pollutants, such as solid particles include particulate matter with diameters of less than 10  $\mu\text{m}$  (PM10), fine particulate matter (PM<sub>2.5</sub>), and the gases sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) and polycyclic aromatic hydrocarbons (PAHs) (7).

Air pollution is so harmful, and even low concentrations of air pollution is a danger to human`s health. Air pollution is now considered as a vital public health issue and it responsible for a growing range of

health impacts. Rapid urbanization means that now we expose to more unhealthy concentrations of air pollutants environments (8).

The problem of ambient air pollution has become disaster for a long time, and it became worse every day. Transportation is the main cause of air pollution in big cities(6). Degree of air pollution in the overcrowded cities is amongst the greatest in the universe, causing serious human health impacts and affecting water and land ecosystems. Tehran, Beijing, Sao Paulo, Shanghai, Cairo, Bangkok, Mexico City and Jakarta are the most polluted cities in the universe (9).

### **Breast cancer:**

In women Breast cancer consider as the most frequent cancer (10). One of the big reason of death and complications around the world is breast cancer(1). Breast cancer is the mostly detection cancer and the prominent reason of cancer death among females in all around the world(11). The occurrence and fatality of cancer is growing universal, especially in developing state (12). These findings are in accordance with Globocan Cancer incidence reports. It is estimated that 1.7million new cases detected and 521,900 death occur from this disease in 2012 in the worldwide (11). Incidence of breast cancer is so different between countries, with the highest incidence in the United States of America and North America and with the lowest incidence in Africa and Asia (13). Breast cancer singly calculate for 25% of whole cancer cases and 15% of whole cancer deaths in women (11). Increasing the incidence rates is reported up to 5% per year (14). In the countries of Asia, by having 59% of population in the world, have the greatest occurrence of breast cancer, with 44% of deaths, 39% of new cases and the world's five-year survivors about 37% (15).

International diversity in breast cancer incidence indicates differences in risk factors(11). Since the range of well-known risk factor cannot explain the incidence of breast cancer we should search for other risk factors (1). Estimated only around one-third of new cases of breast cancer are happening due to well-known risk factors, and a lot of causes remain unknown. So it is a hypothesis that environmental exposures may also go with breast cancer (16). A large number of articles on animals showed that animals that exposed to air pollution increase in mammary gland tumors (3). In general, breast cancer mortality is much greater in the urban population (areas of industrialized) than rural ones and the only "urban factor" constantly noted in the literatures is air pollution (16). Several studies have shown that air pollution have relationship with the increased risk of morbidity and death of patients with breast cancer (14, 16, 17).

### **Literature review:**

Bonner et al. (2005):

They assumed that being subject to PAHs in early life may have special emphasis in the cause of breast cancer. They carried out a population-based, case-control study which about being exposure to PAHs in

early life has the danger of breast cancer in New York. In their study Cases (n = 1,166) were women with historically proved breast cancer, and controls (n = 2,105) were matched by race, age, and the same township to cases. In conclusion they declare that the risk of postmenopausal breast cancer may increase by PAHs; although, other confounders linked with geography cannot be excluded (17).

Nie et al. (2007):

They have conducted a case–control study of breast cancer risk and exposure to traffic emissions during life. 1,170 cases and 2,116 controls selected from Citizens of Erie and Niagara Counties. After examining they find that being more subjected to traffic emissions in menarche period had statistically significant relation with higher risk of breast cancer in premenopausal and at the time of a woman’s first delivery for breast cancer in postmenopausal (18).

Crouse et al. (2010):

A hospital-based case–control study was carried out about Breast Cancer and its relationship with exposure to traffic-related air pollution in Montreal, Canada. NO<sub>2</sub> is known as an indicator of pollution related to traffic. They expand a regression model by using land to predict concentrations of average annual NO<sub>2</sub>. The Places for sampling were selected by using a location-allocation model which put samplers in region likely to have high changes in pollution related to traffic and high population densities. Samplers were deployed in 133 places across the Island of Montreal on three seasons (spring, summer, winter). Cases were chosen from all 18 hospitals in the area that cured breast cancer and to reduce the possible recall bias, control subjects had one of 32 other selected sites of event, historically proved cancers. At the end they declare to find documents of connection between the ambient concentrations of NO<sub>2</sub> and incidence of postmenopausal breast cancer (19).

Hung (2012):

In an article about “Taiwan air pollution related to traffic and risk of mortality from breast cancer”, they reported that being subject to vast amount of PM<sub>2.5</sub>, a proxy measure of PAHs, May linked with an increased risk of mortality from breast cancer. The measure of mortality pay more attention in this study rather than incidence (16).

Ahmadi et al. (2013):

Their investigation aimed to evaluate if the number of cases and occurrence of the most prevalent cancers in Saudi Arabia significantly related to exposure to NO<sub>2</sub>. At different Atmosphere Level, link between NO<sub>2</sub> concentration and the most prevalent cancers were improved in geographically heavy regression analysis. High correlation were seen between NO<sub>2</sub> concentration and breast and lung cancer incidences, followed by bladder, prostate, ovarian cancers and cervical, Endorsing findings of other studies (2).

Huo et al. (2013):

This study was implemented in China, to study the long-term effects of air pollution on breast cancer. They analyzed 1,832 female patients who were detected suffering from breast cancer from Qilu hospital and also who had inhabited in the similar cities for at least ten years before their diagnosis. The PM concentration was detected and arranged due to the yearly mean and daily mean of the PM10 concentration from the environmental protection Bureau. Patients were arranged into three categories in order to the PM10 class of their habitation (high PM, medium PM, and low PM). Number of patients with invasive breast cancer cases significantly increased among High PM exposure patients, in compared to the Low PM class. In addition, they declare magnified effect of ambient PM on tumor grade in Estrogen receptor positive cases, but not Estrogen receptor negative cases. No differences were seen between groups due to (progesterone receptor) PR status or HER- 2 statuses (20).

Hystad et al (2014):

In their case-control study (N=cases 619 pre- menopausal and N=1140 postmenopausal) and (N=controls 611 premenopausal and N=1261 postmenopausal) they found positive link among breast cancer occurrence and long-term exposure to ambient NO<sub>2</sub>. This study hypothesized that traffic pollution may have connection with the progress of breast cancer, with a larger relations in pre-menopausal women (21).

Reding (2015):

This cohort Sister Study includes 47,591 women. However they found no connection between invasive breast cancer and PM<sub>2.5</sub>, PM<sub>10</sub>, or NO<sub>2</sub>, they found associated between NO<sub>2</sub> and a growth risk of ER+/PR+ breast cancer. They reported that for a differential role of air pollution there is biological plausibility by hormone receptor status (22).

White et al (2016):

Their study aims to investigate “breast cancer incidence in relation to multiple long-term PAH sources”. PAH exposure is ubiquitous. Humans subjected to PAHs during their life from variety sources, such as diet, environmental tobacco smoke (ETS), cigarette smoking, indoor and outdoor air pollution. In this population-based case-control study (1508 breast cancer cases/ 1556 controls), they found that groups who exposed to PAH sources have a rise in breast cancer incidence about 30-50% (23).

Totally although there are many other cancer-related risk factors associated with living in ‘dirty’ cities (i.e. exposure to other environmental toxins, higher levels of chronic stress, more inactive lifestyles, less healthful diets, etc.), when researchers in their study exclude as many of these other factors as possible it still seems that air pollution remains an important variable in increasing a breast cancer risk or dying from breast cancer (16, 18, 20). From both natural experiments and epidemiological studies, benefits of reducing exposure to air pollution are well reported (24). Usage of renewable sources of energy and improved energy efficiency in buildings can be useful. Pragmatic public health program possibly need to be established or changed in the fastest time possible. There is a need to develop preventive health

policies and health planning services to improve women life. Such as education and information, traffic management and remove old cars. (25). Also there are some essential requirements in our society such as absenteeism of practical cancer registries system in several countries, including Iran (12) .It should be notice that reducing the effects from urban outdoor air pollution is largely beyond the control of each person and need to take action by government authorities at the national, regional and even international levels (26).

### **Conclusion:**

Our review concluded a feasible correlation between air pollution and breast cancer risk in female at general and total level. Although the mechanisms for how air pollution has affection on the occurrence or progression of breast cancer is unknown, but because it was determined the relationship between these two variables, action for preventive efforts to improve health in females and quality of their life to protect them from air pollution is necessary, specially who at high risk of advancing breast cancer.

It was found some recommendation for further study while reviewing the previous studies such as:

- More studies should be designed to find duration of exposure to air pollution in association with the advancement of breast cancer.
- More research about the role of underlying mechanisms of air pollutants in the breast cancer development is needed.
- Even though a connection was seen between breast cancer and exposure to air pollution, most reports based on the aggregate data, if being subjected to air pollution was found in individual-level data, our conclusion could be more trustworthy. Thus these remain an active area of future research.

### **References:**

1. Keramatinia A, Hassanipour S, Nazarzadeh M, Wurtz M, Monfared AB, Khayyamzadeh M, et al. Correlation Between Nitrogen Dioxide as an Air Pollution Indicator and Breast Cancer: a Systematic Review and Meta-Analysis. *Asian Pacific Journal of Cancer Prevention*. 2016;17(1):419-24.
2. Al-Ahmadi K, Al-Zahrani A. NO<sub>2</sub> and cancer incidence in Saudi Arabia. *International journal of environmental research and public health*. 2013;10(11):5844-62.
3. Garcia E, Hurley S, Nelson DO, Hertz A, Reynolds P. Hazardous air pollutants and breast cancer risk in California teachers: a cohort study. *Environmental Health*. 2015;14(1):1.
4. Raaschou-Nielsen O, Andersen ZJ, Hvidberg M, Jensen SS, Ketzel M, Sørensen M, et al. Air pollution from traffic and cancer incidence: a Danish cohort study. *Environmental Health*. 2011;10(1):1.
5. Clancy L, Goodman P, Sinclair H, Dockery DW. Effect of air-pollution control on death rates in Dublin, Ireland: an intervention study. *The lancet*. 2002;360(9341):1210-4.

6. Yazdanparast T, Salehpour S, Masjedi MR, Azin SA, Seyedmehdi SM, Boyes E, et al. Air pollution: the knowledge and ideas of students in Tehran-Iran, and a comparison with other countries. *Acta Medica Iranica*. 2013;51(7):487.
7. Loomis D, Huang W, Chen G. The International Agency for Research on Cancer (IARC) evaluation of the carcinogenicity of outdoor air pollution: focus on China. *Chin J Cancer*. 2014;33:189-96.
8. Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environmental geochemistry and health*. 2015;37(4):631-49.
9. Khalilzadeh S, Khalilzadeh Z, Emami H, Masjedi MR. The relation between air pollution and cardiorespiratory admissions in Tehran. *Tanaffos*. 2009;8(1):35-40.
10. Brody JG, Moysich KB, Humblet O, Attfield KR, Beehler GP, Rudel RA. Environmental pollutants and breast cancer. *Cancer*. 2007;109(S12):2667-711.
11. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA: a cancer journal for clinicians*. 2015;65(2):87-108.
12. Maryam M, Ali-Akbar H, Eshagh D, Abbas B, Kazem Z. Completeness and underestimation of cancer mortality rate in Iran: a report from Fars province in Southern Iran. *Arch Iran Med*. 2015;18(3).
13. Tarawneh E, Al-Attayat N. Exploration of barriers to breast-self examination and awareness: a review. *ME-JN*. 2013;7(6):3-7.
14. Sadjadi A, Nourai M, Ghorbani A, Alimohammadian M, Malekzadeh R. Epidemiology of breast cancer in the Islamic Republic of Iran: first results from a population-based cancer registry. 2009.
15. American Cancer Society. *Global Cancer Facts & Figures 3rd Edition*. Atlanta: American Cancer Society. 2015.
16. Hung L-J, Tsai S-S, Chen P-S, Yang Y-H, Liou S-H, Wu T-N, et al. Traffic air pollution and risk of death from breast cancer in Taiwan: Fine particulate matter (PM<sub>2.5</sub>) as a proxy marker. *Aerosol Air Qual Res*. 2012;12:275-82.
17. Bonner MR, Han D, Nie J, Rogerson P, Vena JE, Muti P, et al. Breast cancer risk and exposure in early life to polycyclic aromatic hydrocarbons using total suspended particulates as a proxy measure. *Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*. 2005;14(1):53-60.
18. Nie J, Beyea J, Bonner MR, Han D, Vena JE, Rogerson P, et al. Exposure to traffic emissions throughout life and risk of breast cancer: the Western New York Exposures and Breast Cancer (WEB) study. *Cancer Causes & Control*. 2007;18(9):947-55.

19. Crouse DL, Goldberg MS, Ross NA, Chen H, Labrèche F. Postmenopausal breast cancer is associated with exposure to traffic-related air pollution in Montreal, Canada: a case-control study. *Environmental health perspectives*. 2010;118(11):1578.
20. Huo Q, Zhang N, Wang X, Jiang L, Ma T, Yang Q. Effects of ambient particulate matter on human breast cancer: is xenogenesis responsible? *PloS one*. 2013;8(10):e76609.
21. Hystad P, Villeneuve PJ, Goldberg MS, Crouse DL, Johnson K, Group CCRER. Exposure to traffic-related air pollution and the risk of developing breast cancer among women in eight Canadian provinces: a case-control study. *Environment international*. 2015;74:240-8.
22. Reding KW, Young MT, Szpiro AA, Han CJ, DeRoo LA, Weinberg C, et al. Breast cancer risk in relation to ambient air pollution exposure at residences in the sister study cohort. *Cancer Epidemiology Biomarkers & Prevention*. 2015;24(12):1907-9.
23. White AJ, Bradshaw PT, Herring AH, Teitelbaum SL, Beyea J, Stellman SD, et al. Exposure to multiple sources of polycyclic aromatic hydrocarbons and breast cancer incidence. *Environment international*. 2016;89:185-92.
24. Laden F, Schwartz J, Speizer FE, Dockery DW. Reduction in fine particulate air pollution and mortality: extended follow-up of the Harvard Six Cities study. *American journal of respiratory and critical care medicine*. 2006;173(6):667-72.
25. DES U. World economic and social survey 2013: sustainable development challenges. United Nations, Department of Economic and Social Affairs, New York. 2013.
26. WHO. Public health policy for outdoor air quality. [http://www.who.int/phe/health\\_topics/outdoorair/databases/public\\_health\\_policy/en/](http://www.who.int/phe/health_topics/outdoorair/databases/public_health_policy/en/).