PBL 3
Li Muting
26002204613

Literature Review

-- The impact of air pollution on humans

All components of air pollution are harmful to human health, but the most serious impact is from atmospheric PM which contains various toxic substances and carries them into the respiratory tract. When breathing in PM, coarse particles will remain in the nasal cavity and upper respiratory tract of people, and fine and ultrafine particles of PM may though the alveoli and enter the bloodstream[1]. Research has shown that the increase in mortality rate is related to short-term and long-term exposure to PM. The percentage increase of all-cause mortality associated with short-term PM exposure is between 0.4% and 1.5% for each 20 micrograms/m3 increase in coarse PM10, and between 0.6% and 1.2% for every 10 micrograms/cubic meter increase in finer PM2.5. [2] These increases are much higher in Southeast Asian countries, especially in China and India, people there is facing high-levels air pollution due to the rapid development of industry and dense population. [3]

In addition, air pollution is also related to the increase in mortality and hospitalization caused by cardiovascular and respiratory disease.

Air pollution and Vascular disease

Various studies have found that there are relationships between air pollution and cardiovascular diseases, the most important one is after breathing in the PM, the activation of inflammatory pathways, primary and secondary hemostasis and production of reactive oxygen species. [4] In addition, PM increase by 10 μG/m3 is associated with a 4.5% increased risk of acute coronary syndrome (unstable angina and myocardial infarction) [5].

About heart failure, in a British study, long-term exposure to PM and NO2 was associated with an increased incidence rate. Moreover, a recent analysis showed a positive correlation between short-term increases in gas composition and PM and the risk of hospitalization for heart failure. [6]

With regard to Cerebrovascular disease, studies have shown that there are relationships between air pollution and stroke incidence rate and mortality. In the United States and Denmark, for every 10 micrograms/cubic meter increase in long-term PM2.5 exposure, non fatal and fatal strokes increased by 35% and 83%[7]. Similarly, in China, exposure to PM10 and NO2 is also associated with an increase in cerebrovascular mortality. [8]

Air pollution and Respiratory disease

Exposure to air pollutants is associated with Chronic obstructive pulmonary disease (COPD), acute respiratory infection, cancer and respiratory allergy[9]. In a study on the number of admissions related to heart and lung diseases in the United States, for every 10 micrograms/cubic

meter increase in PM10, the number of COPD admissions increased by 2.5%[10]. Another study found that a sudden increase in PM2.5 is associated with an increased risk of hospitalization for COPD by approximately 0.9%[11]. On the other hand, a study conducted in the heavily polluted city of Los Angeles reported that since 1994, with the gradual improvement of air quality in the city area, the lung function of adolescents has improved[12].

Association with other diseases

The data indicates a connection between air pollutants and the deterioration of allergic diseases (rhinitis, eczema, etc.) [13]. Diabetes and cognitive effects are also associated with exposure to air pollutants. And recently, people are concerned that air pollutants may have an impact on pregnancy and the first extrauterine life cycle [14]. Some studies have also found an association between exposure to air pollution during pregnancy and low birth weight at term and delayed psychomotor development in childhood [15].

Reference

[1] Brown JS, Zeman KL, Bennett WD (2002) Ultrafine particle deposition and clearance in the healthy and obstructed lung. Am J Respir Crit Care Med 166:1240–1247 https://www.atsjournals.org/doi/10.1164/rccm.200205-399OC

[2] Stieb DM, Judek S, Burnett RT (2002) Meta-analysis of time-series studies of air pollution and mortality: effects of gases and particles and the influence of cause of death, age, and season. J Air Waste Manag Assoc 52:470–484 https://www.tandfonline.com/doi/abs/10.1080/10473289.2002.10470794

[3] Gao H, Chen J, Wang B et al (2011) A study of air pollution and city clusters. Atmos Environ 45:3069–3077 https://www.sciencedirect.com/science/article/pii/S1352231011002536?via%3Dihub

[4] Franchini M, Mannucci PM (2011) Thrombogenicity and cardiovascular effects of ambient air pollution. Blood 118:2405–2412 https://ashpublications.org/blood/article/118/9/2405/29501/Thrombogenicity-and-cardiovascular-effects-of

[5] Pope CA 3rd, Muhlestein JB, May HT, Renlund DG, Anderson JL, Horne BD (2006) Ischemic heart disease events triggered by short-term exposure to fine particulate air pollution. Circulation 114:2443–2448 https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.106.636977

[6] Shah ASV, Langrish JP, Nair H, McAllister DA, Hunter AL, Donaldson K et al (2013) Global association of air pollution and heart failure: a systematic review and meta-analysis. Lancet 382:1039–1048 https://www.sciencedirect.com/science/article/pii/S0140673613608983?via%3Dihub

[7] Miller KA, Siscovick DS, Sheppard L, Shepherd K, Sullivan JH, Anderson GL et al (2007) Long-term exposure to air pollution and incidence of cardiovascular events in women. N Engl J Med 356:447–458
https://www.nejm.org/doi/full/10.1056/NEJMoa054409

[8] Zhang P, Dong G, Sun B, Zhang L, Chen X, Ma N et al (2011) Long-term exposure to ambient air pollution and mortality due to cardiovascular disease and cerebrovascular disease in Shenyang. China. PLoS One 6:e20827
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0020827

[9] Brunekreef B, Holgate ST (2002) Air pollution and health. Lancet 360:1233–1242
https://www.sciencedirect.com/science/article/pii/S0140673602112748?via%3Dihub

[10] Zanobetti A, Schwartz J, Dockery DW (2000) Airborne particles are a risk factor for hospital admissions for heart and lung disease. Environ Health Perspect 108:1071–1077
https://ehp.niehs.nih.gov/doi/10.1289/ehp.001081071

[11] Dominici F, Peng RD, Bell ML, Pham L, McDermott A, Zeger SL et al (2006) Fine particulate air pollution and hospital admission for cardiovascular and respiratory diseases. JAMA 295:1127–1134
https://jamanetwork.com/journals/jama/fullarticle/202503

[12] Gauderman WJ, Urman R, Avol E, Berhane K, McConnell R, Rappaport E et al (2015) Association of improved air quality with lung development in children. N Engl J Med 372:905–913
https://www.nejm.org/doi/10.1056/NEJMoa1414123

[13] Kloog I, Coull BA, Zanobetti A, Koutrakis P, Schwartz JD (2012) Acute and chronic effects of particles on hospital admissions in New-England. PLoS ONE 7:e34664
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0034664

[14] Stieb DM, Chen L, Eshoul M, Judek S (2012) Ambient air pollution, birth weight and preterm birth: a systematic review and meta-analysis. Environ Res 117:100–111
https://www.sciencedirect.com/science/article/pii/S0013935112001764?via%3Dihub

[15] Dadvand P, Parker J, Bell ML, Bonzini M, Brauer M, Darrow LA et al (2013) Maternal exposure to particulate air pollution and term birth weight: a multi-country evaluation of effect and heterogeneity. Environ Health Perspect 121:267–373
https://ehp.niehs.nih.gov/doi/10.1289/ehp.1205575