IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 10, October 2020

DOI 10.17148/IARJSET.2020.71017

Air Pollution Indoor and Outdoor: Quality of the Air and Its Effects on Asthma and Other Concerns

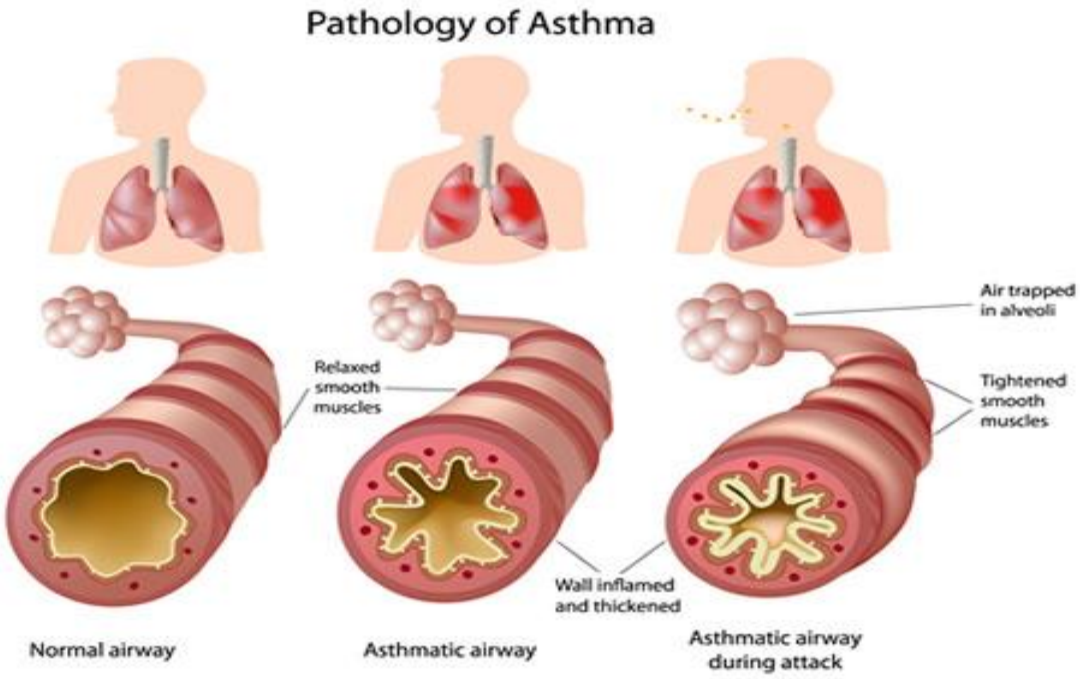
Naresh Kumar Pilli*[1], Ramyalatha Vanga[2]

Andhra University, Visakhapatnam, India[1,2]

Abstract: Outdoor air pollution is mainly because of traffic, industries. Asthma is a condition of our body, which cause breathing difficult and trigger cough, and shortness of breath. Prevalence of Asthma is increasing in most of the countries especially developed countries because of lots of traffic and industries. In this paper we will discuss about how pollutants, particulate matter, and traffic cause the air pollution, and how the air pollution leads to asthma and other problems related to the body. We will also look at some clinical studies that related asthma to air pollution.

I. INTRODUCTION

Asthma is a chronic disease which involves airways of the lungs, also called bronchial tubes which will allow air to come in and out of the lungs. So, if you have asthma your airways are inflamed, and it makes it difficult for air to pass in and out of lungs, which in turn cause the symptoms like coughing, chest tightness, wheezing. Outdoor air pollution has affected more than 3% of the lives that are lost, due to disability annually in 2010 Global Burden of Disease comparative risk assessment, and the increase in numbers from 2000 reports was notable [1].



Asthma is also one of the common illness of children, which affected around 6 Million US children in 2010 [2]. For asthma patients, the symptoms are related to physical activity. Healthy people develop symptoms only when they are exercising. Not all the pollutants of the air have effects on causing asthma in people. Some most common pollutants that are shown to have pulmonary effects on asthmatics are SO_2, NO_2, particulate matter less than 10 pm aerodynamic diameter (PM_{10}), and O_3. Some of these pollutants induce airway inflammation like $PM_{2.5}$[3-8] and Ozone, and some other cause airway hyper responsiveness like ozone and nitrogen dioxide [3,9], causing asthmatic problems. People with asthma have adverse health effects due to outdoor air pollution. Some of these health effects are like inflammatory changes, and admitting into hospitals and emergency rooms have increased, bronchial hyperresponsiveness, and increase in medication use, immune system changes etc., In this paper we will discuss about air pollutants that can cause asthmatic issues, and different asthmatic issues that can be caused by air pollutants. Let's discuss the air pollutants that cause asthmatic effects:

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 7, Issue 10, October 2020

DOI 10.17148/IARJSET.2020.71017

II. AIR POLLUTANTS THAT CAUSE ASTHMATICS

Nitrogen Dioxide: Nitrogen dioxide is one of those pollutants which is recognized as an important indoor and outdoor pollutant that develops symptoms like wheezing, lower forced expiratory volume in one second [10]. It is generated from gas heaters, automobiles, and cooking ranges. Some studies that are conducted, prove that there is an association between lung function reduction and Nitrogen Dioxide exposure [11,12]. The risk of severity of asthma exacerbations was also linked to Nitrogen Dioxide [13,14,15]. Oxygen reacts with Nitrogen to less extent during high temperature combustion and Nitrogen Dioxide (NO_2) is formed, and at higher extent NO is formed. The main source of NO_2 and NO outdoor is power plants, motor vehicles and fossil fuel burning from industries. Cooking, kerosene heaters are the indoor sources of NO_2.Countries like united states have gas cooking stoves in most of the houses, and it contributes to production of NO_2. [16] Conducted analysis of studies on exposure to NO2 and changes in bronchial hyperresponsiveness.5 studies with people who does not have Asthma and 20 studies with people who already have asthma were analyzed , and it was determined that there is a small but significant increase in BHR after being exposed to NO_2 for people with asthma. And there is an 60% increase in BHR for the people with asthma. Studies that were done on people with exposure to controlled amounts of NO_2 at realistic concentrations did not have pulmonary function decrements in subjects with asthma or healthy subjects.[17] Did a study , and found that there is an increased emergency department visits for asthma during winter time and peak concentration of NO_2 is associated with that in Northern California, and also the same with emergency department visits and respiratory admissions in Greece [18]. In Spain, Barcelona peak NO concentrations are associated with emergency visits for asthma during both winter and summer [19]. The peak concentrations of NO_2 on an average are 58ppb, 69ppb and 50 ppb in Barcelona, Northern California, and Athens. Recent studies show that there is a 30% reduction in NO_2 levels in many countries all over the world due to covid quarantine [20]. As already stated above NO_2 is both an indoor and outdoor pollutant and there is an increase in respiratory issues in children from the NO_2 that is emitted from gas cooking stoves [34].

Sulfur Dioxide: Primary source of Sulfur Dioxide is industrial coal combustion and oil-fired plants, as fossil fuels contain sulfur naturally. Fossil fuel combustion release sulfur oxides and acid aerosols even though they are chemically distinct, they usually are available together as components of complex mixture. SO_2 does not cause chronic or acute adverse effects in animals but is a respiratory irritant when exposed to ambient concentrations [20,21].Lung functions of asthmatics are altered by exposure to low levels of SO_2 [22,23].
Subjects with Asthmatics when they exercise in air containing even low levels as 0.25ppm of SO_2 develop bronchoconstriction within few minutes of exposure. And when these subjects are exposed to SO_2 for a brief period subjects may develop increase in air way resistance with a ventilation for oral breathing forty-one per minute [24-26].A study was conducted by [27,28,29,30] which states that there is an inflammation of lungs when exposed to pollutants inhaled allergen and the pollutants are diesel exhaust particles, nitrogen dioxide, sulfur dioxide, ozone in both animals and humans. Studies were done on subjects who are healthy and whoa are asthmatic by [31,32] and it was found that subjects with asthma are more sensitive to Sulfuric acid inhalation than subjects who are healthy. Even at a low concentration of Sulfuric acids at a level of 70 and 100 µg/m3 and exercising for about 30 minutes Forced Vital Capacity decrement was seen. By using scrubbing equipment in power plants which are coal fired sulfur dioxide exposure is reduced greatly in the developed countries, but it is still problem in developing countries. China author conducted a study on sulfur dioxide association with children with atopy and has seen prevalence of asthma [33].In six thousand pediatricians sulfur dioxide exposure is investigates and it was found that 4500 cases reported obstructive bronchitis during 3 year period in German cities [38]. Exposure to Particulate matter and SO_2 is studied inn 89 children who has asthma for over about 7 months, and there is an increase in respiratory symptoms, increase in medication use, fever and absence to schools with elevated exposure [39]. Inhaling SO_2 in lower concentration by subjects who has asthma, provoked acute airway bronchoconstriction similar to subjects who don't have asthma but inhaled higher concentration of SO_2 [35].

Particulate Matter: Particles of size greater than 10 micrometer aerodynamic diameter could damage the lower airways and lung portions which exchanges the gas. High concentrations of SO_2 and particulate is associated with increase in morbidity and mortality from the past studies [40-43]. The frequency of respiratory complains and the increase in mortality has raised the doubt that this could be because of exposure to particulate matter. This exposure to particulate matter in 1960's was associated with increase in respiratory symptoms and chronic obstructive lung disease [40]. Severe asthma exacerbations were noticed in subjects with long term, $PM_{2.5}$ exposure [45]. And risk of increase in asthma and hospitalization has increased with PM_{10} exposure [44]. In a study conducted in Utah PEF in subjects with asthma has seen a negative relationship with OM less than or equal to 10 micrometers [46]. A study conducted on hospital admissions have figured that there is an increase in hospital admissions by 5% with PM of size 10. And with PM of size less than or equal to 2.5 µm there is a 4% increase[47].In a study done on 25 children with asthma, it was noted that medication use and symptoms have increase with PM exposure [48].Studies show that out door Pm could easily penetrate indoors [49]. In a study done on homes of children from Seattle of 9 kids in winter, it was noted that indoor to outdoor ratio of PM is

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 10, October 2020

DOI 10.17148/IARJSET.2020.71017

less than 1 which is 0.98 [49].Emissions of PM from biomass are associated with cough, wheezing [50].A study which is done on short term exposure of PM showed that there is a positive correlation between asthma admissions in hospitals for kids and PM concentration[51].

Ozone: Ozone is formed by reactions which are sun driven and involves volatile organic compounds and nitrogen oxides (NOx). There are number of studies conducted to know the effects of O_3 along with the presence of other pollutants. One study observed the interaction between other pollutants and O_3, and it was noted that prior to exposing to O_3 they were exposed to other pollutants, and the response to o has changed in those individuals, and the same happened with vice versa [52].In old studies it was reported that an exposure to O_3 for 45 mins followed by exposure to SO_2 increased bronchial hyperreactivity in adults[53].Children are at more risk than adults with increase in ozone concentration, and hospitalization risk is also more in children than adults [54].the exposure in children to Ozone for short term has caused asthma, also in adults [55,56]. The long-term exposure to ozone cause onset of asthma, and this is not clear yet. Another study has found that that exposure to ozone has increased risk of asthma in adults especially males comparatively [57].Another study conducted in California found that there is 36% to 70% reduction in bronchitis episodes in patients who has asthma with reductions in traffic related ozone [58].

III. CONCLUSION

In this review article we have summarized some studies that show association between air pollution and asthma. Some studies proved that short term air pollution has increased risk of hospitalization, in both adults and children who has asthmatic issues, and caused onset in subjects who don't have prior asthmatic issues. The air pollution is measured in terms of Nitrogen dioxide, sulfur dioxide, PM, Ozone, etc. We as a society all together need to reduce our common activities that could led to polluting air with these pollutants in possible ways.

REFERENCES

[1]. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380:2224–60.
[2]. Centers for Disease Control and Prevention. 2017 Jan 16; Available from: https://www.cdc.gov/asthma/asthmadata.htm. [Ref list]
[3]. Seltzer J, Bigby BG, Stulbarg M, et al. O3-induced change in bronchial reactivity to methacholine and airway inflammation in humans. J Appl Physiol. 1986;60:1321– [PubMed] [Google Scholar]
[4]. Aris RM, Christian D, Hearne PQ, Kerr K, Finkbeiner WE, Balmes JR. Ozone-induced airway inflammation in human subjects as determined by airway lavage and biopsy. Am Rev Respir Dis. 1993;148:1363–72. [PubMed] [Google Scholar]
[5]. Solomon C, Christian DL, Chen LL, et al. Effect of serial-day exposure to nitrogen dioxide on airway and blood leukocytes and lymphocyte subsets. Eur Respir J. 2000;15:922–28. [PubMed] [Google Scholar]
[6]. Frampton MW, Boscia J, Roberts NJJ, et al. Nitrogen dioxide exposure: effects on airway and blood cells. Am J Physiol Lung Cell Mol Physiol. 2002;282:L155–65. [PubMed] [Google Scholar]
[7]. Dales R, Wheeler A, Mahmud M, et al. The influence of living near roadways on spirometry and exhaled nitric oxide in elementary schoolchildren. Environ Health Perspect. 2008;116:1423–27. [PMC free article] [PubMed] [Google Scholar]
[8]. Delfino RJ, Staimer N, Gillen D, et al. Personal and ambient air pollution is associated with increased exhaled nitric oxide in children with asthma. Environ Health Perspect. 2006;114:1736–43. [PMC free article] [PubMed] [Google Scholar]
[9]. Poynter ME, Persinger RL, Irvin CG, et al. Nitrogen dioxide enhances allergic airway inflammation and hyperresponsiveness in the mouse. Am J Physiol Lung Cell Mol Physiol. 2006;290:L144–52. [PubMed] [Google Scholar]
[10]. Bowatte G, Lodge CJ, Knibbs LD, Lowe AJ, Erbas B, Dennekamp M, Marks GB, Giles G, Morrison S, Thompson B, Thomas PS, Hui J, Perret JL, Abramson MJ, Walters H, Matheson MC, Dharmage SC. Traffic-related air pollution exposure is associated with allergic sensitization, asthma, and poor lung function in middle age. J Allergy Clin Immunol.
[11]. Gaffin JM, Hauptman M, Petty CR, Sheehan WJ, Lai PS, Wolfson JM, Gold DR, Coull BA, Koutrakis P, Phipatanakul W. Nitrogen dioxide exposure in school classrooms of inner-city children with asthma. J Allergy Clin Immunol. 2017 [PMC free article] [PubMed] [Google Scholar] [Ref list]
[12]. Ierodiakonou D, Zanobetti A, Coull BA, Melly S, Postma DS, Boezen HM, Vonk JM, Williams PV, Shapiro GG, McKone EF, Hallstrand TS, Koenig JQ, Schildcrout JS, Lumley T, Fuhlbrigge AN, Koutrakis P, Schwartz J, Weiss ST, Gold DR Childhood Asthma Management Program Research G. Ambient air pollution, lung function, and airway responsiveness in asthmatic children. J Allergy Clin Immunol. 2016;137:390–399.
[13]. Tetreault LF, Doucet M, Gamache P, Fournier M, Brand A, Kosatsky T, Smargiassi A. Severe and Moderate Asthma Exacerbations in Asthmatic Children and Exposure to Ambient Air Pollutants. Int J Environ Res Public Health. 2016:13.
[14]. Orellano P, Quaranta N, Reynoso J, Balbi B, Vasquez J. Effect of outdoor air pollution on asthma exacerbations in children and adults: Systematic review and multilevel meta-analysis. PLoS One. 2017;12:e0174050.
[15]. Disease and Health Inequalities Attributable to Air Pollutant Exposure in Detroit, Michigan.Martenies SE, Milando CW, Williams GO, Batterman SA Int J Environ Res Public Health. 2017 ct 19; 14(10):.[PubMed] [Ref list]
[16]. Folinsbee LJ.Does nitrogen dioxide exposure increase airways responsiveness?.Toxicol Indust Health. 1992; 8: 273-283 PubMed Google Scholar
[17]. Norris G YoungPong SN Koenig JQ Larson TV Sheppard L Stout JW.An association between fine particles and asthma emergency department visit for children in Seattle. Environ Health Perspect. 1999; 107: 489-493
[18]. Pantazopoulou A Katsouyanni K Kourea-Kremastinou J Trichopoulos D.Short-term effects of air pollution on hospital emergency outpatient visits and admissions in the greater Athens, and Greece area. Environ Res. 1995; 69: 31-36
[19]. Castellsague J Sunyer J Saez M Anto JM.Short-term association between air pollution and emergency room visits for asthma in Barcelona. Thorax. 1995; 50: 1051-1056
[20]. Ravi Manne, Snigdha Kantheti.COVID-19 and Its Impact on Air Pollution. International Journal for Research in Applied Science and Engineering Technology (IJRASET). 2020; 8(11):344-346 ISSN : 2321-9653 DOI : https://doi.org/10.22214/ijraset.2020.32139 CrossRef

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 10, October 2020

DOI 10.17148/IARJSET.2020.71017

[21]. Alarie YC, Ulrich CE, Busey WM, Krumm AA, MacFarland HN. Long-term continuous exposure to sulfur dioxide in cynomologus monkeys. Arch Environ Health 24:115-128 (1972). 16. Amdur MO. Cummings memorial lecture: the long road from Donora. Am Ind HygAssocJ 35:589-597 (1974).
[22]. Koenig JQ, Pierson WE, Frank NR. Acute effects of inhaled SO, plus NaCl droplet aerosol on pulmonary function in asthmatic adolescents. Environ Res 22:145-153 (1980).
[23]. Sheppard D, Wong WS, Uehara CD, Nadel JA, Boushey HA. Lower threshold and greater bronchomotor responsiveness of asthmatic subjects to sulfur dioxide. Am Rev Respir Dis 122:873-878 (1980).
[24]. Bethel RA, Erie DJ, Epstein J, Sheppard D, Nadel JA, Boushey HA. Effects of exercise rate and route of inhalation on sulfur dioxide-induced bronchoconstriction in asthmatic subjects. Am Rev Respir Dis 128:592-596 (1983).
[25]. Horstman D, Roger LJ, Kehrl H, Hazucha MJ. Airway sensitivity of asthmatics to sulfur dioxide. Toxicol Ind Health 2:289-298 (1986). 25. Kirkpatrick MD, Sheppard D, Nadel JA, Boushey HA. Effect of the oronasal breathing route on sulfur dioxide-induced bronchoconstriction in exercising asthmatic subjects. Am Rev Respir Dis 125:627-631 (1982).
[26]. Linn WS, Venet TG, Shamoo DA, Valencia LM, Anzar UT, Spier CE, Hackney JD. Respiratory effects of sulfur dioxide in heavily exercising asthmatics. Am Rev Respir Dis 127:278-283 (1983).
[27]. Increased specific airway reactivity of persons with mild allergic asthma after 7.6 hours of exposure to 0.16 ppm ozone.Kehrl HR, Peden DB, Ball B, Folinsbee LJ, Horstman DJ Allergy Clin Immunol. 1999 Dec; 104(6):1198-204.[PubMed] [Ref list]
[28]. Tunnicliffe WS, Burge PS, Ayres JG. Effect of domestic concentrations of nitrogen dioxide on airway responses to inhaled allergen in asthmatic patients. Lancet. 1994;344:1733–36. [PubMed] [Google Scholar]
[29]. Devalia JL, Rusznak C, Herdman MJ, Trigg CJ, Tarraf H, Davies RJ. Effect of nitrogen dioxide and sulphur dioxide on airway response of mild asthmatic patients to allergen inhalation. Lancet. 1994;344:1668–71. [PubMed] [Google Scholar]
[30]. Nel AE, Diaz-Sanchez D, Ng D, Hiura T, Saxon A. Enhancement of allergic inflammation by the interaction between diesel exhaust particles and the immune system. J Allergy Clin Immunol. 1998;102:539–54. [PubMed] [Google Scholar]
[31]. Hanley QS Koenig JQ Larson TV Anderson TL van Belle G Rebolledo V et al.Response of young asthmatic patients to inhaled sulfuric acid.Am Review Respir Dis. 1992; 145: 326-331 View in Article PubMed Crossref Google Scholar
[32]. Koenig JQ Covert DS Larson TV Pierson WE. The effect of duration of exposure on sulfuric acid–induced pulmonary function changes in asthmatic adolescent subjects: a dose-response study. Toxicol Indust Health. 1992; 8: 285-296
[33]. Dong G-H, Chen T, Liu M-M, et al. Gender differences and effect of air pollution on asthma in children with and without allergic predisposition: northeast Chinese children health study. PLoS One. 2011;6:e22470. [PMC free article] [PubMed] [Google Scholar]
[34]. Hasselblad V Eddy DM Kotchmar DJ. Synthesis of environmental evidence: nitrogen dioxide epidemiology studies.J Air Waste Manage Assoc. 1989; 67: 1535-1541 Google Scholar
[35]. Anoop J Chauhan, Sebastian L Johnston, Air pollution and infection in respiratory illness, British Medical Bulletin, Volume 68, Issue 1, December 2003, Pages 95–112, https://doi.org/10.1093/bmb/ldg022
[36]. Guarnieri M, Balmes JR. Outdoor air pollution and asthma. *Lancet*. 2014;383(9928):1581-1592. doi:10.1016/S0140-6736(14)60617-6
[37]. Burbank, Allison J, and David B Peden. "Assessing the impact of air pollution on childhood asthma morbidity: how, when, and what to do." Current opinion in allergy and clinical immunology vol. 18,2 (2018): 124-131. doi:10.1097/ACI.0000000000000422
[38]. Schwartz J, Spix C, Wichmann HE, Malin E. Air pollution & acute respiratory illness in five German communities. Environ Res 1991; 56: 1–14
[39]. Peters A , Dockery DW, Heinrich J, Wichmann HE. Short-term effects of particulate air pollution on respiratory morbidity in asthmatic children. Eur Respir J1997; 10: 872–9
[40]. Lawther PJ, Waller RE, Henderson M. Air pollution and exacerbations of bronchitis. Thorax 25:525-539 (1970).
[41]. Martin AE, Bradley WH. Mortality, fog and atmospheric pollution-an investigation during the winter of 1958-59. Mon Bull Minist Health Public Health Lab Serv Directed Med Res Counc 19:56 (1960).
[42]. Martin AE. Mortality and morbidity statistics and air pollution. Proc R Soc Med 57:969 (1964).
[43]. Mazumdar S, Schimmel H, Higins I. Relation of daily mortality to air pollution-analysis of 14 London winters
[44]. Mazenq J, Dubus JC, Gaudart J, Charpin D, Nougairede A, Viudes G, Noel G Eur J Pediatr. 2017 Jun; 176(6):705-711.
[45]. Byers N, Ritchey M, Vaidyanathan A, Brandt AJ, Yip F J Asthma. 2016; 53(3):245-52.[PubMed] [Ref list]
[46]. Respiratory health and PM10 pollution: a daily time series analysis.Am Rev Respir Dis. 1991; 144: 668-674
[47]. Sheppard L Levy D Norris G Larson TV Koenig JQ.Effects of ambient air pollution on non-elderly asthma hospital admissions in Seattle, 1987-1994.Epidemiology. 1999; 10: 23-30
[48]. Delfino RJ Coate BD Zeiger RS Seltzer JM Street DH Koutrakis P.Daily asthma severity in relation to personal ozone exposure and outdoor fungal spores.Am J Respir Crit Care Med. 1996; 154: 633-641
[49]. Jarvis D Chinn S Luczynska C Burney P.Association of respiratory symptoms and lung function in young adults with use of domestic gas appliances.Lancet. 1996; 347: 426-431
[50]. Short-term Effects of Ambient Air Pollution on Emergency Department Visits for Asthma: An Assessment of Effect Modification by Prior Allergic Disease History.*Noh J, Sohn J, Cho J, Cho SK, Choi YJ, Kim C, Shin DCJ Prev Med Public Health. 2016 Sep; 49(5):329-341.*
[51]. Ding L, Zhu D, Peng D, Zhao Y. Air pollution and asthma attacks in children: A case-crossover analysis in the city of Chongqing, China. Environ Pollut. 2017;220:348–353. [PubMed] [Google Scholar]
[52]. Hazucha MJ, Seal E, Folinsbee U, Bromberg PA. Lung function response of healthy subjects following sequential exposures to NO2 and 03. Am Rev Respir Dis 145:A456 (1992).
[53]. Koenig JQ, Covert DS, Hanley QS, Van Belle G, Pierson WE. Prior exposure to ozone potentiates subsequent response to S02 in adolescent asthmatic subjects. Am Rev Respir Dis 141:377-380
[54]. Concentration-response of short-term ozone exposure and hospital admissions for asthma in Texas.*Zu K, Liu X, Shi L, Tao G, Loftus CT, Lange S, Goodman JE Environ Int. 2017 Jul; 104():139-145.*[PubMed] [Ref list]
[55]. An analysis of asthma hospitalizations, air pollution, and weather conditions in Los Angeles County, California.Delamater PL, Finley AO, Banerjee S Sci Total Environ. 2012 May 15; 425():110-8.[PubMed] [Ref list]
[56]. Short-term associations between ambient air pollutants & pediatric asthma emergency department visits. Strickland MJ, Darrow LA, Klein M, Flanders WD, Sarnat JA, Waller LA, Sarnat SE, Mulholland JA, Tolbert PE Am J Respir Crit Care Med. 2010 Aug 1; 182(3):307-16. PubMed]
[57]. Asthma related to occupational and ambient air pollutants in nonsmokers. Greer JR, Abbey DE, Burchette RJ J Occup Med. 1993 Sep; 35(9):909-15. [PubMed] [Ref list]
[58]. Global goods movement and the local burden of childhood asthma in southern California.*Perez L, Künzli N, Avol E, Hricko AM, Lurmann F, Nicholas E, Gilliland F, Peters J, McConnell R Am J Public Health. 2009 Nov; 99 Suppl 3():S622-8.* [PubMed] [Ref list]
[59]. Koren, Hillel S. "Associations between criteria air pollutants and asthma." Environmental health perspectives 103.suppl 6 (1995): 235-242.