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*Review Article*

# Effect of Particulate emissions on the Respiratory System of Workers Belonging to Different Industries: An Overview

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## Abstract

In the present era a tremendous increase in industries is found which directly linked to raising human population and their associated needs. This industrial revolution brings changes in human life on one hand and have negative impacts on the human life on other hand as these industries are source of tons of wastes that released into the atmosphere. Emissions includes particulate matters (aflatoxins, endotoxins and dust), heavy metals (Cr, Cd, Pb, Hg and Ni), gases ($NH_3$, $SO_2$, $NO_x$, $H_2S$ and CO), and volatile organic compounds. The current review study emphasized on emissions from four major industries such as poultry, leather, brick kiln and paint industry and its influence on worker's health. It is well known the emissions produced significant negative impact on the respiratory system of the workers particularly those which are continuously exposed to particulate enriched environments. The emissions can cause bronchopulmonary aspergillosis, chronic bronchitis and coal workers' pneumoconiosis. The acute and chronic symptoms also depend on time and duration of exposure and concentration of emissions. It is reported in literature studies most of the respiratory issues are due to lack of proper precaution measures, awareness and personal protective equipment's in these industries. So, there is need to highlight these industries related problems to create general awareness among people and to aware regulatory bodies so that they bring strictness on the use of proper personal equipment and to control the impacts of industrial emissions on the lungs of the workers.

## Keywords

Particulate matter, Industrial revolution, Lung, Damage

## Introduction

Particulate matter (PM) is the term used to describe fine solid matter that is suspended in air [1]. Due to industrial revolution, there is tons of wastes which is released from different industries and goes into the environment.

According to literature, there are two types of particulates $PM_{2.5}$ and $PM_{10}$ and these are directly released into the environment or produced indirectly as a result of chemical reactions between various primary pollutants [2, 3].

The main source of atmospheric pollution in the majority of cities is breathable particulate matter that enter the respiratory system by the mouth and nose. $PM_{10}$ stands for particles with a diameter under 10 µm. $PM_{2.5}$ stands for the dangerous particulate matter with mass median aerodynamic dimensions smaller than 2.5µm and mostly affects human health.

The health of living things, including humans, is influenced by a number of variables, including size, concentration, type, and duration of inhaled PM. High PM levels are anticipated to be present in 90% of the world's population, resulting in over 42,000 early deaths year, according to WHO (2018). According to studies by Cambra-López et al. [4], the three main sites where foreign chemicals are absorbed are the skin, lungs, and gastrointestinal system. Pig and poultry houses release up to 30% and 50% respectively, of the overall emissions of particulates from agriculture in Europe [4].

Skin absorption has the potential to be a substantial route of absorption because the skin is constantly exposed to foreign compounds such as gases, solvents, and substances in solution. Despite having a large surface area for absorption, the structure of the skin acts as a barrier to absorption. This is because the epidermis' outer cells are tightly packed with keratin, has a little blood supply, and has dead cells as its outermost layer. Although the dermis beneath is vascularized, due to its thickness and numerous cell layers, it will also inhibit absorption [5].

From a toxicological standpoint, lung exposure to dangerous chemicals has a greater impact than skin exposure. The air that employees breathe could contain a variety of dangerous substances. In a workplace situation, whether industrial or not, they could be gases (like carbon monoxide), solvent vapours (like methylene chloride), aerosols, or particle debris (like asbestos). Additionally, harmful chemicals like nitrogen oxides may be present in the air that employees breathe. The human lungs have a surface area of 50 to 100 $m^2$, a sufficient blood supply, and a two cell membrane-thick wall separating the lifeblood from the air in the alveolus. As a result, the lungs quickly and effectively absorb the substance [6].

Many drugs are generally taken by mouth, many foreign chemicals are frequently absorbed through diet, and many dangerous substances are ingested either accidentally or on purpose. The digestive system is therefore a crucial site for the absorption of exogenous chemicals [7].

# 1. Harmful impacts of emission on poultry workers

Poultry industry is contributing on large scale as 1.3% to the country's GDP. Pakistan's poultry industry is a vital and crucial part of the country's agricultural economy. Since Pakistan's commercial poultry industry began in the 1960s, a sizable amount of the country's population's daily protein intake has come from chicken. Poultry faming provides millions of eggs and meat for the human need as well as it also provides thousands of jobs for the workers [8]. However, it is noticed the workers who work in the poultry industry are at higher risk for lungs illness than usual chance of developing chronic lung disorders. The occupants mostly have higher risk of lungs diseases, such as coughing, sore throats, eye irritation, headaches, and pressure in the chest, muscular aches, asthma, and other diseases [9].

### 1.1. Harmful hazards of allergens on poultry workers

The environment of the poultry is rich with several allergens of the respiratory tract such are, organic dust, mycotoxins, endotoxins, and disinfectants. The air at poultry farms also contains a variety of potentially dangerous contaminants, such as gases e.g. carbon oxides, sulphur oxides and ammonia. According to the Ellen et al., organic dust found in chicken coops, is a complex mixture of feces pieces, feed, litter, and animal remnants including feathers and skin [10]. Moreover, several studies also reported the poultry farms have a large concentration of airborne microbes such as fungi, viruses, bacteria, and their metabolites [11-14]. Research on the synergistic effects of organic dust and ammonia are studied and it is reported that might the emissions increased the risk of respiratory dysfunction for workers in confined animal environments However, in Pakistan one of the study showed least effects of emissions due to healthy worker survivor effect [15].

### 1.1.1. Harmful hazards of aflatoxins on poultry workers

The discharge of numerous hazardous compounds from poultry farms, including aflatoxins (AF), has a significant negative influence on the health of the workers. According to Bhatnagar et al., the fungi *A. parasiticus* and *A. flavus* create aflatoxins. Aflatoxins are mycotoxin, which can colonise the respiratory tract and result in fungal rhinosinusitis or bronchopulmonary aspergillosis [16-17]. There are many types of aflatoxin but alflatoxin AF $B_1$ activates TLR4 signalling to promote influenza replication (IR) and increase virus related lung damage (VRLD) [18-19].

### 1.1.2. Harmful hazards of endotoxin on poultry workers

Endotoxins, which are created by the outer membrane of Gram-negative bacteria, make up a sizeable component of organic dust [20-22]. Because endotoxins have pro-inflammatory qualities, it is thought that they contribute to the emergence of occupational lung illnesses such as organic dust toxic syndrome (ODTS), chronic airway obstruction, and asthma-like syndrome [23-25]. Significant endotoxin concentrations have been discovered in poultry beam houses [26-28].

# 2. Harmful impacts of emission on Leather workers

Leather industry is second-ranked sector of Pakistan's economy and its most rapidly growing export- industry. It contributes 5% to the nation's GDP and employs more than 500,000 people. The tanning process transforms unfinished hides and skins into leather. Tanning involves the use of numerous chemicals, which are ultimately released into the atmosphere in various ways, producing contamination of the air, land, and water [29-31]. According to Hashmi et al. (2017), the leather industry may benefit a society that aims to use less, reuse more, and recycle everything. Tannery wastes cause major health risks for workers by polluting the air, land, and water. Exposure to the toxic environment of the leather industry has been related to several carcinomas, hepatic and neurological disorders, asthma, dermatitis, and other conditions [32-34]. Even though the leather business contributes significantly to the economy, the workers are concerned about the rising levels of harmful petrol emissions [35].

### 2.1. Effluents released from leather industries

The effluents of leather industries contain 40 distinct sorts of compounds, including hazardous heavy metals, acids, and dyes, and as a result, tanneries produce various categories of harmful waste that are regarded to be substantial environmental contaminants [36-37].

According to Gnanasekaran et al. (2010), an increased atmospheric concentration of pollutants like chromium, NOX, SOX, fine particulate matter (PM10), volatile organic chemicals (VOC), and hydrogen sulphide, may cause an increase in allergic diseases, pulmonary asthma, and improved response of the airways to inhaled allergens [38-40].

### 2.2. Harmful hazards of heavy metals on Leather workers

There are many types of heavy metals found in the leather industry such as Chromium (Cr), Cadmium (Cd), Lead (Pb), Mercury (Hg), and Nickle (Ni). Cr compounds are pulmonary irritants for the workers when they inhaled in such contaminated environment. Lung, nasal, and sinus cancer risk all rise with prolonged inhalation of Cr (VI) compounds [41].

### 2.2.1. Effects of cadmium

Occupational exposure to cadmium can lead to a variety of adverse health effects including cancer. Acute inhalation exposure (high levels over a short period of time) to cadmium can result in flu-like symptoms (chills, fever, and muscle pain) and can damage the lungs. Chronic exposure (low level over an extended period of time) can result in kidney, bone and lung disease [42-43].

### 2.2.2. Effects of lead

According to epidemiological research, lead exposure may contribute to the prevalence of asthma in lead-exposed workers [44-45].

#### 2.2.3. Effects of mercury

Acute inhalation of elemental mercury vapour at high concentrations can result in chemical pneumonitis, dyspnea, chest pain, and a dry cough in addition to lung inflammation [46-47].

#### 2.2.4. Effects of nickel

People who have breathed dust containing specific nickel compounds while working in nickel rich environment have experienced the most severe adverse health effects from nickel exposure, including chronic bronchitis, decreased lung function, and lung and nasal sinus cancer [48-49].

# 3. Harmful hazards of Brick kiln on human lungs

One of the World fastest-growing businesses, the brick making sector employs a sizable population. The workers of the brick kiln exposed to the particulate enriched environment at brick kiln [50-52]. During the manufacturing of the bricks a different type of gases emits from the chimneys of the brick kilns. Brick kiln emissions are mostly made up of fine coal particles, dust, organic materials, and trace amounts of gases like $SO_2$, NOx, $H_2S$, and CO [53].

### 3.1. Coal workers' and Pneumoconiosis

The use of coal in brick kiln cause Coal workers' pneumoconiosis (CWP), a potentially incapacitating lung condition, can result from breathing in respirable coal dust. Early on, coughing, shortness of breath, and heaviness in the chest are the main symptoms. Sometimes black sputum (mucus) might be coughed up. Initially, these symptoms might appear after exerting oneself, but as the illness worsens, they might start to appear even when one is at rest [54].

### 3.2. Effects of sulphur dioxide

Sulphur dioxide inhalation irritates the lungs, eyes, throat, nose, and other respiratory organs. Sore throat, runny nose, burning eyes, and cough are typical symptoms. High concentrations inhaled might enlarge the lungs and make breathing difficult. Burns or irritated skin might result from coming into touch with sulphur dioxide vapour [55-56].

### 3.3. Effects of nitrous oxide

The nitrous oxide also shows harmful effects on the respiratory system of the workers. Nitrous oxide causes a decrease in tidal volume and an increase in respiratory rate. The increase in respiratory rate is a consequence of central nervous system activation and possibly activation of pulmonary stretch receptors [57-59]. Usually, minute ventilation is maintained. It also leads to a reduction in the ventilatory response to hypoxia and hypercapnia. Inhalation of nitrous oxide depresses tracheal mucociliary flow and neutrophil chemotaxis. This may increase the incidence of post-operative respiratory complications [60-61].

### 3.4. Effects of hydrogen sulphide

The environment of the brick kiln also contains hydrogen sulphide gas which having tremendous effect on the lungs of the workers. Low concentrations (50 ppm) of inhaled hydrogen sulphide can quickly cause irritation of the nose, throat, and lower respiratory tract, as well as pulmonary symptoms such as coughing, shortness of breath, and bronchial or lung haemorrhage [62-63]. In contrast, occlusive bronchiolitis and pulmonary oedema may result from a high H2S concentration (50–500 ppm), which can cause persistent inflammation and lung fibrosis [64-65].

### 3.5. Effects of combustion of coal

During the combustion of coal for the bricks manufacturing in brick kiln carbon monoxide (CO) is produced. A small concentration of the CO has significant effect on the human lungs. CO has shown cellular and tissue-

protective benefits at low concentrations despite systemic and cellular toxicity at high concentrations. Models of acute lung injury are hyperoxia, hypoxia, ischemia-reperfusion, and mechanical ventilation [66].

# 4. Harmful hazards of paint industry on human lungs

Varnishes, lacquers, stains, coatings, primers, and other coverings are all included in the term "paint," which refers to a variety of paint industry products. Resins, pigments, fillers, solvents, and other components are combined to create paint. Paints can be found in suspensions that are solid, liquid, or gaseous. There are several companies that release paint industry waste into the environment untreated, which has a negative impact on the ecosystem. One of the sectors of the Pakistani economy that is growing quickly is the paint business [67-68].

### 4.1. Components of paint

Paint products contain thousands of different chemical substances, including pigments, extenders, binders, additives, and solvents like benzene, toluene, xylene, ketones, and glycol ethers. Although the patterns and levels of exposure to particular agents may differ from those of painters, paint industry employees are potentially exposed to the chemicals included in paint products [69].

### 4.2. Effects of volatile organic compounds on Paint workers

The industrial VOCs benzene and toluene, which are frequently found in indoor environments, are utilised significantly in industry. Due to their lipophilicity, these substances have the potential to be hazardous due to the accumulation of lipid bilayers in cellular membranes and concentration in fatty deposits after prolonged exposure [70-71]. However, one of its main target organs is the lung, which helps to cause the effects of inhaling benzene, particularly because it biotransforms lung cells into reactive metabolites [72]. There are little publications on the effects of toluene on the airways, despite the fact that it is widely known for its neurotoxicity and oxidative damage in a variety of organs [73-74].

#### 4.2.1. Effects of xylene

An aromatic hydrocarbon called xylene is a common solvent in the paint industry. It is a combustible liquid that should only be used with extreme caution. The vapours are quickly absorbed by the lungs after exposure. The nose and throat became irritated after undergoing a 3-5 minutes acute inhalational exposure to mixed xylene at a concentration of 200 ppm [75] [76]. An autopsy of a worker who passed away after spending many hours painting was described by Morley et al. At the acute exposure of 100 ppm, focal regions of intra-alveolar haemorrhage, pulmonary oedema, and severe lung congestion were observed. The indications and symptoms of workers who have been exposed to mixed xylene over time have been extensively studied by Uchida et al. Workers who are exposed to xylene vapours on a regular basis have been reported to have a considerable increase in throat and nasal irritation [77-78].

#### 4.2.2. Effects of glycol ethers

Humans who are exposed acutely (over a short period of time) to high concentrations of the glycol ethers develop narcosis, pulmonary edoema, and major epatic and renal damages. Humans may experience neurological and blood consequences from chronic (long-term) exposure to glycol ethers, including exhaustion, nausea, tremor, and anaemia [79].

### 4.3. Protective measures

The use of certified respiratory protection equipments are the most crucial step in protection of a worker's health from dangerous respiratory threats, followed by applying realistic engineering and administrative control measures.

The requirement for regular pre-employment training is emphasised by researchers in order to guarantee that employees are properly educated about the possible risks and safety precautions associated with solvent exposure. Employers can assist increase awareness and a safer working environment for people in the paint business by offering frequent training [80-81]. Industrial hazards can be avoided with the use of appropriate personal

protective equipment (PPE). This includes safety clothes, helmets, and other overhead working equipment. Always choose the best PPE for the task at hand, and set an example for others. Do not skimp on workplace safety.

## Conclusion

It was concluded there is effect of environment exposure on worker for respiratory disorders. Along with this, the occupationally exposed person to aflatoxins, dust, heavy metals (chromium, cadmium, lead, mercury and nickel), hazardous gases, and harsh solvents in poultry, leather, brick kiln and paint industries faces the risk of experiencing injury to their skin, liver, and renal functions. This study emphasised on the need for occupational health regulations, effective monitoring, and preventative measures to safeguard the health and wellbeing of exposed workers.

## References:


1. Arslan S, Aybek A (2012) Particulate matter exposure in agriculture. Air Pollution. A Comprehensive Perspective, 3.
2. Després V, Huffman JA, Burrows SM, Hoose C, Safatov A, et al. (2012) Primary biological aerosol particles in the atmosphere: a review. Tellus B: Chem Phy Meteorol 64(1): 15598.
3. Pozzer A, Tsimpidi AP, Karydis VA, De Meij A, Lelieveld J (2017) Impact of agricultural emission reductions on fine-particulate matter and public health. Atmos. Chem Phy 17: 12813-12826.
4. Cambra-López M, Aarnink AJ, Zhao Y, Calvet S, Torres AG (2010) Airborne particulate matter from livestock production systems: A review of an air pollution problem. Environ Poll 158: 1-17.
5. Poet TS, McDougal JN (2002) Skin absorption and human risk assessment. Chem Biol Interact 140: 19-34.
6. Davies CN (1985) Absorption of gases in the respiratory tract. Ann Occup Hyg 29: 13-25.
7. Levine RR (1970) Factors affecting gastrointestinal absorption of drugs. Am J Dig Dis 15: 171-88.
8. Hussain J, Rabbani I, Aslam S, Ahmad HA (2015) An overview of poultry industry in Pakistan. Worlds Poult Sci J 71: 689-700.
9. Arné P, Thierry S, Wang D, Deville M, Le Loc'h G, et al. (2011). Aspergillus fumigatus in Poultry. Int J Microbiol 1-14.
10. Ellen HH, Bottcher RW, Von Wachenfelt E, Takai H (2000) Dust levels and control methods in poultry houses. J Agric Saf Health 6: 275.
11. Yasmeen R, Ali Z, Tyrrel S, Nasir ZA (2019) Estimation of particulate matter and gaseous concentrations using low-cost sensors from broiler houses. Environmental monitoring and assessment 191:1-10.
12. Zhang J, Wei X, Jiang L, Li Y, Li M, et al. (2019) Bacterial community diversity in particulate matter ($PM_{2.5}$ and $PM_{10}$) within broiler houses in different broiler growth stages under intensive rearing conditions in summer. J Appl Poult Res 28: 479-489.
13. Radon K, Danuser B, Iversen M, Monso E, Weber C, Hartung J et al. (2002) Air contaminants in different European farming environments. Ann. Agric Environ Med 9:41-48.
14. Lee JW, Choi SP, Thiruvenkatachari R, Shim WG, Moon H (2006) Submerged microfiltration membrane coupled with alum coagulation/powdered activated carbon adsorption for complete decolorization of reactive dyes. Water Res 40: 435-444.
15. Yasmeen R, Ali Z, Tyrrel S, Nasir ZA (2020) Assessment of respiratory problems in workers associated with intensive poultry facilities in Pakistan. Saf Health Work 11: 118-124.
16. Rylander R, Petersen Y, Donham KJ (1990) Questionnaire evaluating organic dust. Am J Ind Med 17: 121–126.
17. Syed M, Saleem T, Shuja-ur-Rehman Iqbal MA, Javed F, Khan MBS, Sadiq K (2010) Effects of leather industry on health and recommendations for improving the situation in Pakistan. Arch Environ Occupat. Health 65: 163-172.
18. US Department of Health and Human Services, Centers for Disease Control and Prevention. National health and nutrition survey (NHANES) respiratory health and exhaled nitric oxide (ENO) procedures manual; Published January (2008).

19. Uchida Y, Nakatsuka H, Ukai H, Watanabe T, Liu YT, et al (1993) Symptoms and signs in workers exposed predominantly to xylenes. Int Arch Occup Environ Health. 64: 597-605.
20. US EPA Office of Air and Radiation, Office of Air Quality Planning and Standards (1997). Fact sheet-EPAs recommended final ozone and particulate matters standards[S], Updated Air Quality Standards.
21. Lelia C, Maria S (2012) Benefits and costs of the informal sector: the case of brick kilns in Bangladesh. J Environ Prot.
22. Mm A, EZ A, IF, SA GF, MH, A (2001) Health profile of workers in the paint industry.
23. Monsó E, Schenker M, Radon K, Riu E, Magarolas R, et al (2003) Region-related risk factors for respiratory symptoms in European and California farmers. Eur Respir J 21:323-331.
24. Hashmi GJ, Dastageer G, Sajid MS, Ali Z, Malik MF, et al. (2017) Leather industry and environment: Pakistan scenario. Int J Appl Biol Forensics 1: 20-25.
25. Guttikunda SK, Khaliquzzaman M (2014) Health benefits of adapting cleaner brick manufacturing technologies in Dhaka, Bangladesh. Air Qual Atmos Health 7:103-112.
26. Hankinson JL, Odencrantz JR, Fedan KB (1999) Spirometric reference values from a sample of the general U.S. population. Am J Respir Crit Care Med 159: 179-87.
27. Hashmi GJ, Dastageer G, Sajid MS, Ali Z, Malik MF, (2017) Leather industry and environment: Pakistan scenario. Int J Appl Biol Forensics 1(2): 20-25.
28. Ferris BG (1978). Epidemiology standardization project (American Thoracic Society). Am Rev Respir Dis. 118(6 Pt 2):1–120.
29. Khattak S, Zhang QQ, Sarfraz M, Muhammad P, Ngowi EE, et al. (2021) The role of hydrogen sulfide in respiratory diseases. Biomolecules 11:682.
30. Sia CK, Nor SHM, Ong P, Othman MSC (2015) Preparation of paint by using palm oil fly ash, pofa based pigment. In: the 3rd ICMER.
31. Carpenter WS, Lee BC, Gunderson PD, Stueland DT (2002) Assessment of personal protective equipment use among Midwestern farmers. Am J Ind Med.42: 236-247.
32. El-Nezami H, Kankaanpaa P, Salminen S, Ahokas J (1998) Ability of dairy strains of lactic acid bacteria to bind a common food carcinogen, aflatoxin b1. Food Chem Toxicol 36: 321-326.
33. Islam MS, Ahmed MK, Habibullah-Al-Mamun M, Islam KN, Ibrahim M (2014) Arsenic and lead in foods: a potential threat to human health in Bangladesh. Food Addi Contam: Part A 31: 1982-1992.
34. Lim KG, Mottram C (2008) The use of fraction of exhaled nitric oxide in pulmonary practice. Chest 133: 1232-1242.
35. Maithel S, Lalchandani D, Malhotra G, Bhanware P, Uma R, et al (2012) Brick kilns performance assessment. New Delhi, India: Greentech; p. 164.
36. Mitloehner FM, Calvo MS (2008) Worker health and safety in concentrated animal feeding operations. J Agric Saf Health 14:163-87.
37. Alli BO (2008) Fundamental principles of occupational health and safety. 2nd ed. Geneva: International Labour Organization. p. 15.
38. Waalkes MP (2000) Cadmium carcinogenesis in review. J Inorg Biochem 79: 241-244.
39. Lockman LE (2002) Allergic contact dermatitis and new-onset asthma. Can Fam Physician 48:1907-1909.
40. Steenland K, Boffetta P (2000) Lead and cancer in humans: where are we now? Am J Ind Med 38: 295-299.
41. Maithel S, Vasudevan N, Johri R, Kumar A (2002) Pollution reduction and waste minimization in brick making. Habitat Place, Lodhi Road, New Delhi: Tata Research Institute.
42. Boffetta P, Merler E, Vainio H (1993) Carcinogenicity of mercury and mercury compounds. Scand J Work Environ Health 19:1-7.
43. Carruth AK, Duthu SG, Levin J, Lavigne T (2008) Behavior change, environmental hazards and respiratory protection among a southern farm community. J Agromedicine 13: 49-58s.
44. Shen HM, Zhang QF (1994) Risk assessment of nickel carcinogenicity and occupational lung cancer. Environ Health Perspect 102 : 275-282.

45. Huston (2002) A study of brick-making processes along the Texax portion of the USMexico border. Austin.
46. Ilo (2011) Children in hazardous work: what we know, what we need to do. Industry, brick b by brick: the herculean task of cleaning up the Asian.
47. Erbe SO (2011). Technical, economical and organizational analysis of informal brick production in Tercera Chica, SLP, Mexico (Doctoral dissertation, SO Erbe).
48. Ismail M, Muhammad D, Khan FU, Munsif F, Ahmad T, et al (2012) Effect of brick kilns emissions on heavy metal (Cd and Cr) content of contiguous soil and plants. Sarhad J Agric 28: 403-409.
49. Skinder BM, Pandit AK, Sheikh AQ, Ganai BA (2014) Brick kilns: cause of atmospheric pollution. J Pollut Eff Cont 2: 3.
50. McCunney RJ, Morfeld P, Payne S (2009) What component of coal causes coal workers' pneumoconiosis? J Occup Environ Med 51: 462-71.
51. Khan R, Vyas H (2008) A study of impact of brick industries on environment and human health in Ujjain City (India). J Environ Res Dev 2: 421-425.
52. Khattak JK, Parveen S (1988) Cooperative research programme on micronutrients in Pakistan [annual report] (1987-88). Deptt. of Soil Sci. Peshawar, Pakistan: Agric University.
53. Haskard CA, El-Nezami HS, Kankaanpää PE, Salminen S, Ahokas JT (2001) Surface binding of aflatoxin B(1) by lactic acid bacteria. Appl Environ Microbiol 67: 3086-3091.
54. Iversen M, Kirychuk S, Drost H, Jacobson L (2000) Human health effects of dust exposure in animal confinement buildings. J Agric Saf Health 6: 283-288.
55. Khalaf EM, Mohammadi MJ, Sulistiyani S, Ramírez-Coronel AA, Kiani F, et al (2022) Effects of sulfur dioxide inhalation on human health: a review. Rev Environ Health.
56. Banks A, Hardman JG (2005) Nitrous oxide. Contin Educ Anaesth Crit Care Pain 5:145-148.
57. Lundberg I, Håkansson M (1985) Normal serum activities of liver enzymes in Swedish paint industry workers with heavy exposure to organic solvents. Br J Ind Med 42: 596-600.
58. Erbe SO (2011) Technical, economical and organizational analysis of informal brick production in Tercera Chica, SLP, Mexico (Doctoral dissertation, SO Erbe).
59. Ferris BG (1978) Epidemiology standardization project (American Thoracic Society). Am Rev Respir Dis. 118:1-120.
60. Gautam RP, Prasain JN (2011) Current situation of occupational safety and health in Nepal. General federation of Nepalese trade unions (GEFONT). GEFONT Plaza: Man Mohan Labour Building. Kathmandu, Nepal: Putalisadak.
61. Gessesse A, Mula F, Lyantagaye S, Nyina Wamwiza L, Mattiasson B, et al. (2011). Industrial enzymes for sustainable bioeconomy: large scale production and application in industry environment and agriculture in eastern Africa.
62. Ryter SW, Ma KC, Choi AMK (2018) Carbon monoxide in lung cell physiology and disease. Am J Physiol Cell Physiol 314: C211-27.
63. Rana A, Haseeb Z, Baig A, Naseer N, Bilal S (2022) Monitoring of environment and human health impact assessment of paint industry. SSRG Int J Agric Environ Sci 9:54-61.
64. Rastogi SK (2002) Enironmental factors and physiological strain in workers employed in brick kilns. Indian J Occup Environ Med 6:66-70.
65. de Oliveira HM, Dagostim GP, da Silva AM, Tavares P, da Rosa LA, et al. (2011) Occupational risk assessment of paint industry workers. Indian J Occup Environ Med 15: 52-58.
66. Donham KJ, Gustafson KE (1982) Human occupational hazards from swine confinement. Ann Am Conf Gov Ind Hyg 2:137-142.
67. Donham KJ, Popendorf WJ (1985) Ambient levels of selected gases inside swine confinement buildings. Am Ind Hyg Assoc J 46: 658-661.
68. Peltonen K, el-Nezami H, Haskard C, Ahokas J, Salminen S (2001) Aflatoxin b1 binding by dairy strains of lactic acid bacteria and bifidobacteria. J Dairy Sci. 84(10): 2152-2156.
69. Pariselli F, Sacco MG, Ponti J, Rembges D (2009) Effects of toluene and benzene air mixtures on human lung cells (A549). Exp Toxicol Pathol 61: 381-386.

70. Bijetri B, Sen D (2014) Occupational stress among women moulders: A study in manual brick manufacturing industry of West Bengal. Age (yrs) 24: 4-16.
71. Basu K, Sahu S, Pauls G (2008) Women and work. Asian-Pacific newsletter on Occupational Health and safety. Finnish Institute of Occupational Health Topeliuksenkatu 41 a A FI-00250, Helsinki.
72. Bauer MA, Coppolo DP (1993) Agricultural lung disease: prevention. Semin Respir Crit Care Med 14: 83-89.
73. T Rajan ST, Malathi N (2014) Health hazards of xylene: a literature review. J Clin Diagn Res 8: 271-274.
74. Ramazzini B (1940). De morbis artificum Berardini Ramazzini diatriba [Diseases of workers]. Chicago: The University of Chcago Press; 1940.
75. Kirtana A, Seetharaman B (2022) Comprehending the role of endocrine disruptors in inducing epigenetic toxicity. Endocr Metab Immune Disord Drug Targets 22: 1059-1072.
76. Kirychuk SP, Dosman JA, Reynolds SJ, Willson P, Senthilselvan A, et al (2006) Total dust and endotoxin in poultry operations: comparison between cage and floor housing and respiratory effects in workers. J Occup Environ Med 48: 741-748.
77. Hassan AAEH, Elnagar SAEM, El Tayeb IM, Bolbol SAEH (2013) Health hazards of solvents exposure among workers in paint industry 3:87-95.
78. Morley R, Eccleston DW, Douglas CP, Greville WE, Scott DJ, et al. (1970) Xylene poisoning: A report on one fatal case and two cases of recovery after prolonged unconsciousness. Br Med J 3: 442-443.
79. Mpofu D, Lockinger L, Bidwell J, McDuffie HH (2002) Evaluation of a respiratory health program for farmers and their families. J Occup Environ Med 44: 1064-1074.
80. Nelson KW, Ege JF Jr, Ross M (1943) Sensory response to certain industrial solvent vapors. J Ind Hyg Toxicol. 25: 282-285.
81. Golbabaei F, Islami F (2000) Evaluation of workers' exposure to dust, ammonia and endotoxin in poultry industries at the province of Isfahan, Iran. Ind Health 38:41-46.

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