Muhammad Fadli R_Litrev

by Jajang Nurjaman

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Review Article

Risk Factors Associated with Symptoms of Respiratory Disorders in Red Brick Industry Workers : Literature Review

Muhammad Fadli Ramadhansyah[1*], Onny Setiani[1], Budiyono[1]

[1] Departemen Kesehatan Lingkungan, Fakultas Kesehatan Masyarakat, Universitas Diponegoro, Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang, Indonesia 50275

* Corresponding Author, email: mhmdfadlir@gmail.com

Abstract

Making bricks is an informal home industry with a significant dust exposure risk. An initial assessment discovered that 10 brick producers were having difficulty breathing and coughing. Numerous risk factors contribute to the development of respiratory symptoms, including dust exposure, duration of exposure, length of work, kind of job, usage of Personal Protective Equipment (PPE), and smoking behaviors. The purpose of this systematic review is to determine association of dust exposure and risk variables for respiratory symptoms in employees in the brick sector. Article searches were conducted through the PubMed, Scopus, ProQuest, Science Direct, Portal Garuda Indonesia, Sinta, and Google Scholar. There are 21 articles that have been reviewed. According to one report, exposure to PM 2.5 and PM10 dust might result in a 75% reduction in essential lung capacity. Additional risk factors for respiratory symptoms include dust exposure, length of exposure, length of work, type of work, usage of personal protective equipment (PPE), and smoking behaviors. The risk factors indicated above are associated with an increased incidence of respiratory symptoms, which are shown by indications such as reduced vital lung capacity, coughing, shortness of breath, asthma, bronchitis, headaches, and body pains.

Keywords: *Risk Factors, Symptoms of Respiratory Disorder, Brick*

1. Introduction

For a long time, air pollution has been a source of health issues, particularly in industrialized nations with a high concentration of industry activity and motorized vehicles. The usage of fuel and incomplete combustion, as well as additional risk factors such as dust exposure, length of exposure, length of work, type of work, usage of personal protective equipment (PPE), and smoking behaviors. All variable contribute to air pollution caused by industrial activity. Dust particles and gases created by burning bricks are pollutants produced by the red brick business. Dust and gases produced during the red brick production process are present in the workplace, exposing employees to varying quantities and sizes.(Hafsari, Ramadhian and Saftarina, 2015)

The brick industry is a concentrated region where bricks are manufactured, complete with equipment and a manufacturing method designed by the industrial owner. Workplace factors are described as possible sources of hazard that may arise in the workplace as a result of a work procedure. Chemical variables are one of the possible occupational risks. Dust is one of the most prevalent and harmful chemical elements at work.

Workers in the brick industry doing three things: transportation (moving clay dust and bricks), molding (shaping wet clay into bricks), and baking (burning formed bricks in furnaces). Industrial employees are exposed to these contaminants on a yearly basis). Inhaling these pollutants may induce lung inflammation, which can result in a variety of respiratory disorders, including bronchitis, emphysema, asthma, and impaired lung function or occupational diseases.(Siregar, Wahyuni *et al.*, 2020)

The availability of raw bricks may range from 20,000 to 25,000 pieces, and the procedure might take up to 24 hours. Workers must wait at the burn site to load fuel in the form of firewood, maize cobs,

husks, or wood saw debris on a regular basis. This process generates combustion smoke, which includes a variety of pollutants such as CO, SO_2, NO_2 gas, and dust with particle sizes of 2.5 micrometers (PM2.5) and 10 micrometers (PM10) that may irritate workers' respiratory systems.(Hussan and Sheikh, 2013)

A work environment that is full of dust, steam, gas, and other contaminants that can be interferes with health condition. This often causes respiratory issues or impairs crucial lung capacity Exposure to fuel-derived pollutants received by industrial workers every day can trigger inflammation in the lungs which causes various respiratory diseases such as bronchitis, emphysema, asthma, and decreased lung function or occupational diseases.

The maximum dust concentration in the workplace is 3 mg/m^3 according to the Decree of the Minister of Manpower and Transmigration of the Republic of Indonesia No. 13 of 2011 about Threshold Values for Physical and Chemical Factors in the Workplace. Workers who are exposed to this dust may have health issues such as a reduction in forced expiratory volume in one second and a decrease in vital capacity volume.(Menteri Tenaga Kerja dan Transmigrasi, 2011)

Exposure of dust may precipitate the onset of acute and chronic respiratory diseases. Dust particles that may cause acute respiratory issues include coal dust, cement, cotton, asbestos, chemical compounds, poisonous gases, and dust from rice mills (organic dust), among others. Numerous variables impact the incidence of illnesses or respiratory tract ailments caused by dust. These variables include dust parameters such as particle size, shape, concentration, solubility, and chemical properties, as well as exposure time. Individual aspects include the lungs' defensive systems, the respiratory tract's structure and physiology.(Sutiari *et al.*, 2021)

Epidemiological studies indicate that each increment of 10mg/m^3 PM_{10} increases the incidence of persistent cough by 10% to 25%. Even though they experience these symptoms, employees have never sought medical attention since both symptoms are deemed typical and both are attributed to the worker's age.(Soedjono et al, 2003)

According to the International Labor Organization (ILO) estimation, there are 2.2 million job-related deaths per year, 350,000 of which are fatal accidents and 270 million of which are non-fatal work accidents. Every year, 160 million workers are plagued with occupational diseases. Chronic disease bacteria cause between 30% and 40% of these occupational problems, with 10% resulting in lifelong impairment.(International Labour Organization, 2015)

Occupational diseases arise as a result of a person's job and are unaware of the risk factors present in the workplace. This illness is caused by risky behaviors and environments. Dust exposure might result in acute or persistent respiratory issues. Dust particles that may cause acute respiratory issues include coal dust, cement, cotton, asbestos, chemical compounds, poisonous gases, and dust from rice mills (organic dust), among others.

Numerous variables impact the incidence of illnesses or respiratory tract ailments caused by dust. These variables include dust parameters such as particle size, shape, concentration, solubility, and chemical properties, as well as exposure time. Individual aspects include the lungs' defensive systems, the respiratory tract's structure and physiology.(Harmanto, 2012)

Coughing, shortness of breath, a runny nose, and chest discomfort are all symptoms of respiratory distress. A person's exposure to toxins in the lungs will build up over time. Aside from environmental exposure, the characteristics of the workers themselves, dust exposure, length of exposure, length of work, type of work, usage of personal protective equipment (PPE), and smoking behaviors can all influence the symptoms of respiratory disorders. The object of this research is to identify worker exposure to brick dust as well as risk factors for respiratory disorders.

2. Methods

The goal of this review is to synthesize the findings of past research on the variables linked with respiratory diseases symptoms in red brick industry employees. National and international periodicals serve as data sources. The journal search conducted for this study used the keywords debu bata merah

dengan gejala gangguan pernapasan' and 'debu bata merah dengan gangguan fungsi pernapasan' for journals published with Indonesian language, and the keywords dust exposure symptoms of respiratory disorder in brick craftsmen' and 'respiratory disorder in the brick manufacturing industry' for journals published with English language. Journals are located using a database such as PubMed, Scopus, ProQuest, Science Direct, Portal Garuda Indonesia, Sinta, and Google Scholar. The publications were chosen based on the observational research design utilized.

The process of selecting article starts with a quick scan at the title, followed by a study of the abstract for parallels to the research issue, specifically a link between risk factors and the prevalence of respiratory symptoms. There were 15 articles that matched out of 272 that were discovered. The papers were then chosen for a full text evaluation based on the inclusion criteria that had been established. The study's inclusion criteria were as follows;

1. Articles published in 2011-2021
2. Articles with the type of observational research
3. Respondents used in the study of red brick industrial workers
4. The dependent variable in the article is symptoms of respiratory disorder
5. The research data in the article is in the form of primary data which is carried out directly by the researcher

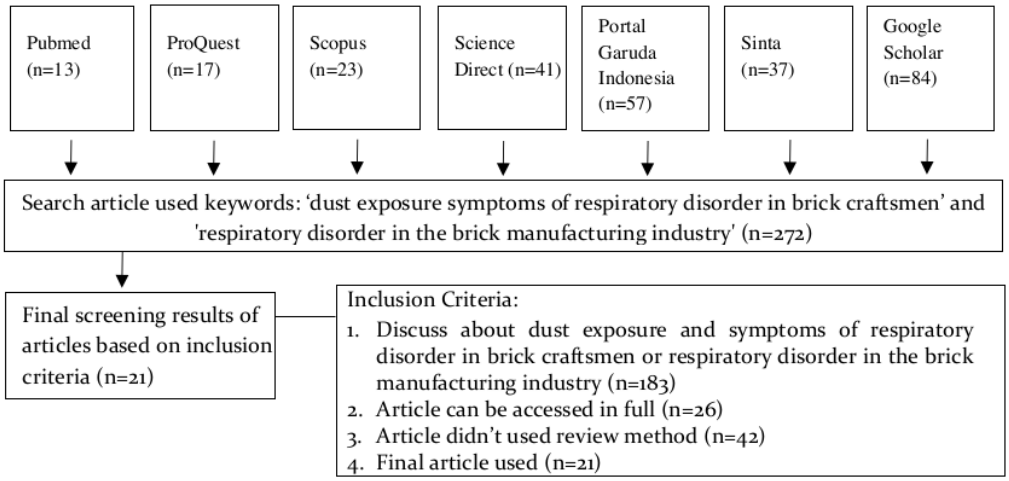

Figure 1. Flow Chart Screening Article

3. Result and Discussion

All of the papers were researched in developed nations such as Nepal, India, and Indonesia. The type of research in the article being studied is analytic observational. There are ten articles that are cross sectional in nature. The research used a total of 34 to 692 samples, based on a review of ten chosen studies. The sample size was greater in a cross-sectional design research.

Not all papers state that the questionnaire was first validated for validity and reliability. Rufiat (2019), Shiraz (2012), Wilda (2020), and Sheta (2015) employed a questionnaire developed from earlier research and tailored to the study site's requirements. The incidence of respiratory symptoms is established using the results of interviews between the researcher and the responder to ensure the validity of the data gathered.(Shaikh *et al.*, 2012; Sheta and Laithy, 2015; Siregar, Wahyuni *et al.*, 2020)

According to the findings of a review of ten selected articles, all articles stated that dust from the red brick manufacturing process had a significant relationship with symptoms of respiratory disorders when the p value 0.05 or the OR value and the lower and upper limits of the 95 percent confidence interval (CI) value of more than 1 were considered. Dust exposure, duration of exposure, length of work, type of

work, usage of personal protective equipment, and smoking habit contribute to the causing symptoms of respiratory problems.(Gupta *et al.*, 2019)

Table 1. Result Synthesis Matrix

No	Main Idea	Similarities of Research Findings
1	Dust Exposure (Joshi and Dudani, 2008; Bhat *et al.*, 2014; Das, 2014; Sanjel *et al.*, 2016; Siregar, Wahyuni *et al.*, 2020; Benny Yulianto et al. 2021)	The results of existing research indicate that dust exposure is a risk factor for the occurrence of respiratory symptoms in brick industry workers.
2	Exposure Duration (Hour/Day) (Guttikunda, Begum and Wadud, 2013; Bhat *et al.*, 2014; Bijetri and Sen, 2014; Sheta and Laithy, 2015; Navya C J et al., 2017)	The results of existing research indicate that the length of exposure is a risk factor for the occurrence of respiratory symptoms in brick industry workers.
3	Length of work (Year) (Irjayanti A et al., 2011; Shaikh *et al.*, 2012; Guttikunda, Begum and Wadud, 2013; Sheta and Laithy, 2015; Tandon *et al.*, 2017; Siregar, Wahyuni *et al.*, 2020; Raza and Ali, 2021)	The results of existing research indicate that working period is a risk factor for the occurrence of respiratory symptoms in brick industry workers.
4	Type of Work (Oviera A, Jayanti S and Suroto, 2007; Shaikh *et al.*, 2012; Sheta and Laithy, 2015; Sanjel *et al.*, 2016; Gupta *et al.*, 2019; Ramadhansyah, Dewanti and Setiani, 2020; Siregar, Wahyuni *et al.*, 2020)	The results of existing research indicate that the type of work is a risk factor for the occurrence of respiratory symptoms in brick industry workers.
5	Usage Of Personal Protective Equipment (PPE) (Pariyar, et al., 2013; Sanjel *et al.*, 2016; Kazi and Bote, 2019; Siregar, Wahyuni *et al.*, 2020; Benny Yulianto et al., 2021; Sutiari *et al.*, 2021)	The results of existing research indicate that the use of PPE is a risk factor for the occurrence of respiratory symptoms in brick industry workers.
6	Smoking Habits (Muhammad Ismail *et al.*, 2012; Sheta and Laithy, 2015; Kazi and Bote, 2019; Siregar, Wahyuni *et al.*, 2020; Benny Yulianto et al., 2021; Raza and Ali, 2021)	The results of existing research indicate that smoking is a risk factor for the occurrence of respiratory symptoms in brick industry workers.

Based on the findings of the article synthesis, symptoms of respiratory diseases were found in the research utilizing a questionnaire to assess whether or not employees had symptoms of respiratory illnesses. The findings of a previous study synthesis identified risk variables that cause the onset of respiratory problems in brick industry employees, such as; dust exposure, duration of exposure, length of work, type of work, usage of personal protective equipment, and smoking habits.

A. **Dust Exposure**

Air pollution is of particular importance since it has a direct impact on the respiratory system. Air pollution is one of the many man-made environmental disasters that are now occurring across the planet.(Joshi and Dudani, 2008) Pollution is increasing at a considerably faster pace in emerging nations than it is in developed ones. Automobile exhaust, construction emissions, industrial manufacturing emissions, hospital wastes, and other types of pollution are all examples.(Sanjel *et al.*, 2016) Depending on the kind of fuel used, brick kilns mainly generate PM, CO, SO_2, volatile organic compounds, nitrogen oxides (NOX), and heavy metals. As public awareness of environmental pollution has grown, government authorities have been regularly monitoring brick kiln emissions.(M Ismail *et al.*, 2012; Das, 2014)

Dust is defined as solid particles emitted by biological and inorganic objects as a result of natural or mechanical processes such as packing, softening, processing, blasting, quick destruction, and so on. Dust, according to another definition, is a microscopic particle with a solid shape measuring 0.1 to 100 microns that results from mechanical operations such as rubbing, blasting, and crushing of a material.(Siregar, Wahyuni *et al.*, 2020)

Dust is a substance or particle with a size of 1 - 500 microns that is suspended in the air (Suspended Particulate Matter). Dust is often used as an indication of indoor and outdoor air pollution. Furthermore, dust is used to assess the amount of risk to the environment and human health.(Benny Yulianto et al., 2021)

Air is filtered, warmed, and humidified as it enters the nasal cavity. Dust is breathed as solid particles or as a mixture of dust particles and smoke. The hair in the nose filters dust with a big and coarse particle size.(Bhat *et al.*, 2014) While this is occurring, fine particles will penetrate the mucosal layer. Dust that enters the lungs produces pulmonary fibrosis, which impairs the flexibility of the lung tissue and results in lung development issues, as well as breathing difficulties such as coughing, coughing up phlegm, shortness of breath, and chest discomfort.(Jan T, 1999; Arif M, 2008)

B. **Exposure Duration**

The length of exposure shows a strong correlation with respiratory illness symptoms. The duration of exposure is the time period during which an individual is exposed to dust or contaminants in the environment while doing labor.(International Labour Organization, 2014) Theoretically, exposure for seven hours per day increases the likelihood of developing respiratory illnesses, since these employees are exposed for longer periods of time, particularly those who do dangerous labor, resulting in an increased risk of exposure.(Guttikunda, Begum and Wadud, 2013)

This study is in line with research conducted by Bijetri (2014) who concluded from his research that long exposure with a duration of > 7 hours per day had a greater risk of exposure than < 7 hours per day.(Bijetri and Sen, 2014) Another study that showed the same results was also found in the Wilda study (2022) which showed that the length of exposure had a significant value so that the length of exposure was a risk factor for the occurrence of respiratory symptoms (p = 0.04). Research conducted by Sheta (2015) showed the same results that the length of exposure had a relationship with the incidence of respiratory disorders (p = 0.03). (Sheta and Laithy, 2015; Siregar, Wahyuni *et al.*, 2020)

The longer a worker works, the more dust he is exposed to, and the likelihood of having impaired lung function increases. However, this also depends on the concentration of dust present and the clearance mechanism of each individual, the chemical nature of the dust, dust size, dust particle content, and individual susceptibility.(Navya C J et al.,2017)

The longer a worker works, the more dust he is exposed to, and the likelihood of having impaired lung function increases. However, this also depends on the concentration of dust present and the clearance mechanism of each individual, the chemical nature of the dust, dust size, dust particle content, and individual susceptibility..(Yulaekah S and Adi MS, 2007)

C. **Length of work**

According to the findings of the research evaluated, the length of employment has a substantial link with symptoms of respiratory illnesses.(Guttikunda, Begum and Wadud, 2013) The period of work

that has a higher risk of experiencing symptoms of respiratory disorders is a period of work with a period of 5 years because it has a longer risk of exposure than people who work < 5 years especially if the workplace has a high risk of pollution levels.(Irjayanti A et al.,2012)

This study is in line with research conducted by Supriya (2017) which showed that tenure had a significant relationship with the incidence of respiratory symptoms in red brick industrial workers (p <0.05).(Tandon *et al.*, 2017) Another study that showed the same results was also found in the study of Shiraz (2012) with test results (p <0.05) which showed that there was a relationship between work period and symptoms of respiratory disorders.(Shaikh *et al.*, 2012) Likewise, research conducted by Sheta (2015) shows that there is a very significant relationship between work period and symptoms of respiratory disorders (p = 0.000).(Sheta and Laithy, 2015)

Workers with a working duration of more than 5 years are more likely to have respiratory symptoms because the longer a person works in a dusty work environment, the greater the likelihood of lung damage, and a working period of 5 years will result in respiratory symptoms.(Irjayanti et al., 2012) (Siregar, Wahyuni *et al.*, 2020; Raza and Ali, 2021)

D. **Type of Work**

The sort of labor discussed here is one in which the degree of exposure is similar to that obtained by employees while doing their duties.(Guttikunda et al., 2013) There are two professions involved in the manufacturing of bricks: transportation, molding, and baking.(Sanjel *et al.*, 2016) Molding is a procedure that transforms the material into a rectangular shape. Baking is the technique of burning at a medium heat to gently cook the red bricks.(Siregar, Wahyuni *et al.*, 2020) Following molding and baking, the bricks are positioned using a torch.(Myson, 2018) They may be classified as dangerous occupations, such as molding and styling, or non-risky professions, such as baking, based on these three vocations. In principle, those who do dangerous labor have a larger chance of developing respiratory symptoms because they come into touch with more contaminants than people who do not perform dangerous work.(Ramadhansyah et al., 2020)

This study is in line with research conducted by Shiraz (2012) which shows that the type of work has an influence on the incidence of respiratory symptoms, both in the molding and baking processes with a p value of <0.05.(Shaikh *et al.*, 2012) Another study showed the same results were also found in the Wilda study (2020) which said that the type of work had a relationship with symptoms of respiratory problems because the majority of workers with this type of baking work experienced more coughing and shortness of breath than those who were molding.(Siregar, Wahyuni *et al.*, 2020) Likewise, research conducted by Sheta (2015) shows that there is a very significant relationship that the type of work has a strong relationship with the incidence of respiratory symptoms (p = 0.000).(Sheta and Laithy, 2015)

According to this idea, persons who work in high-risk jobs have a greater chance of acquiring respiratory symptoms because those who work in high-risk occupations have a greater danger of exposure to pollutants. Occupational illnesses are brought about by risky behaviors and working environments.(Oviera A, Jayanti S and Suroto, 2007)

E. **Usage Of Personal Protective Equipment (PPE)**

The use of Personal Protective Equipment (PPE) in the form of masks is one of the risk factors for the occurrence of respiratory symptoms because the use of masks is one of the efforts that can be made to reduce the amount of dust pollutants inhaled by each worker.(Pariyar, Das and Ferdous, 2013) On average, workers who do work do not use personal protective equipment in the form of masks which indirectly increase the risk of developing respiratory symptoms because workers make direct contact with polluters, especially workers who do risky work with higher pollutant levels.(Wahyuni, Ekawati and Sc, 2016)

This study is in line with research conducted by Wilda (2020) which says that the use of personal protective equipment has a relationship with symptoms of respiratory disorders.(Siregar, Wahyuni *et al.*, 2020) Another study showing the same results was also found in Beny's (2021) study which found

that 58 out of 70 respondents did not use personal protective equipment when doing work.(Benny Yulianto et al., 2021) And research conducted by I Gusti (2021) found that the use of personal protective equipment had an influence on the incidence of respiratory symptoms (p = 0.04).(Sutiari *et al.*, 2021)

According to theory, compliance with the use of personal protective equipment is a risk factor that can cause problems if workers do not use it, particularly when working in a hazardous environment because it allows direct contact with dust levels, allowing the dust to be inhaled and settle in the respiratory organs and respiratory tract.t(Pariyar et al., 2013; Sanjel *et al.*, 2016)

The majority of workers lack the initiative to use masks independently, due to the area's location and the type of work that generates a lot of dust. However, using masks made of cloth/clothes has not been effective in containing dust that enters due to the size variation of the dust particles.(Kazi and Bote, 2019)

F. **Smoking Habits**

According to the findings of the study examined, smoking habits have a substantial association with the symptoms of respiratory illnesses.(M Ismail *et al.*, 2012) Cigarettes are unhealthy products, since they contain hazardous and irritating compounds such as nicotine, carbon monoxide, and tar. Nicotine constricts the pulmonary terminal bronchioles, increasing resistance to airflow.(Kazi and Bote, 2019) Moreover, irritation from cigarette smoke increases fluid secretion in the bronchi; and nicotine may paralyze the cilia that transport excess fluid, resulting in a buildup of fluid and difficulty breathing.(Benny Yulianto et al., 2021)

Theoretically, smoking has a fourfold probability of producing blockage compared to non-smokers. Smoking may alter the structural and functional characteristics of the respiratory system and lung tissue. Tobacco use will hasten the loss in lung function. For active smokers, the annual decrease in forced expiratory volume is 28.7 mL.(Siregar, Wahyuni *et al.*, 2020)

This finding is in line with the research conducted by Rufiat (2019) which showed that smoking was a risk factor in the incidence of respiratory symptoms in red brick industrial project workers with a percentage of 24.5% of 420 workers.(Kazi and Bote, 2019) Another study that showed the same results was also found in the study of Ali Raza (2021) which showed that workers with smoking habits experienced a decrease in FVC and FEV1 compared to non-smokers based on measurements using spirometry.(Raza and Ali, 2021) Another study conducted by Sheta (2015) showed that there was a significant relationship between smoking habits and symptoms of respiratory disorders (p = 0.01).(Sheta and Laithy, 2015) Smokers' mucosal cells and mucus glands may expand. While in the small respiratory tract, mucus might accumulate as a result of channel constriction caused by cigarette smoke and dust from the work environment.(Brinkman GL and Coates EO Jr, 1963; International Labour Organization, 2014)

4. Conclusions

Brick kilns are thought to be a major source of rural and urban air pollution. Few studies have rigorously analyzed this issue and fewer have measured the emissions factors and/or modeled their contribution to the ambient particulate pollution levels.

Respiratory disorder may be discovered by indications of interview results utilizing a questionnaire with numerous criteria such as cough (ordinary or with phlegm), shortness of breath, and chest discomfort, and if left untreated, can develop into severe issues such as asthma and bronchitis caused by smoking behaviors, kind of job, duration of exposure, working time, and the usage of personal protection equipment in the form of masks. Additionally, you may employ a reduction in the value of lung capacity to get more precise findings.

On the basis of theory, recommendations include adopting a healthy lifestyle that includes regular exercise, appropriate relaxation, abstinence from tobacco, frequent health checkups, and the use of personal protection equipment such as masks.

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