



**STUDY OF SKIN MORBIDITY PROFILE IN PORTLAND CEMENT
INDUSTRY WORKER AT KHULNA CITY CORPORATION,
BANGLADESH**

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Abstract: Cement, specifically Portland cement is now used for construction and rapid urbanization worldwide. Though development of cement industry in Bangladesh takes back to early fifties this industry is in rapid growth state from about a decade, involving a large number of worker population. High alkalinity of cement and its tiny content of water soluble chromate can cause occupational skin diseases to workers who are involved with any type of cement handling activities. Cement industry workers are mainly low income group people and are driven by poverty, illiteracy, overpopulation and thus can pay little or no attention for health protection and treatment. Therefore, this study aims to identify skin disease status of workers in a Bangladeshi cement industry. Study was conducted among the workers working in a particular cement industry in south-west region of Bangladesh, at *Labanchara, Rupsha* Khulna. Data was collected by questionnaire survey method using modified version of standard questionnaire, which was drafted and pre-tested based on the reconnaissance survey. The study found that workers were suffering from various irritant dermatitis, allergic dermatitis and cement burn of different parts of their body, significantly in hand, forearm and leg. Study revealed, lack of proper sanitation and maintenance of safety equipment, coupled with habit of smoking and working for many years are mostly responsible, besides regular dust exposure for the association of skin diseases in cement workers.

Keywords: Portland cement, irritant contact dermatitis, cement burn, skin disease, Personal protective equipment.

Introduction

Gradual substitution of traditional building structures or patterns by modern high-rise ones has pushed up the use of cement. A faster growth in demand for cement has been observed since mid-1980s worldwide, especially with implementation of large infrastructure projects, increased pace of urbanization, construction of apartment buildings and multistoried shopping complexes in urban areas accompanied by a shift in the taste of rural people for modern houses (Ali & Al-Kodmany, 2012). Development of cement industry in Bangladesh dates back to the early-fifties but its growth in real sense started only about a decade and the country has been experiencing an upsurge in cement consumption for the last five years. These cement industries involve around one third of country's unorganized labor population who are working day and night for their livelihood (IDLC Finance Limited, 2011). Portland cement is a generic term used to describe a variety of building materials and

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a mixture of Calcium oxide (CaO) (62% - 66%), Silicon oxide (SiO₂) (19% - 22%), Aluminum tri-oxide (Al₂O₃) (4%-8%), Ferric oxide (Fe₂O₃) (2% - 5%), Magnesium oxide (MgO) (1% - 2%) and also Selenium, Thallium and other impurities. The cement is valued for their strong adhesive properties when mixed with water. Small amounts of magnesia (MgO), Sodium (Na), Potassium (K), and Sulfur (S) are also present besides sand is added to make concrete (Meo, 2004).

Having plenty of deleterious effects on the surroundings, cement industries have not even spared its workers from adverse health related casualties (Aydin *et al.*, 2010; Vestbo & Rasmussen, 1990; Zeleke *et al.*, 2011). Employees who work with Portland cement are at risk of developing skin problems, ranging from mild and brief to severe and chronic illness (Manjula *et al.*, 2013). The worst part is, life expectancy of workers gets negative (Samet *et al.*, 2000) due to long term exposure of particulate cement matter contaminated air (Perez-Grau, 2009; Pope III & Dockery, 2006). Which are produced in different cement manufacturing stages like, raw material crusher, rotary kiln, cranes, mills, storage silos and packing section etc. (Mwaiselage *et al.*, 2006). Distinctive researches have been pointed Portland cement as a skin irritant (Manjula *et al.*, 2013) because of its caustic, abrasive and moisture sensitive property with the presence of hexavalent chromium [Cr(VI)] in trace amount (Denton *et al.*, 1954; Peck, 1945; Sana *et al.*, 2013). Portland cement can induce caustic burns, sometimes referred to as 'cement burns' which may result in blisters, dead or hardened skin, or black or green skin. In severe cases, these burns may extend to the bone and cause disfiguring scars or disability (Llachapelle, 1986). However, allergological inflammations are usually experienced by all the cement workers who are involved in cement handling, mixing, cleaning and packing (Frey, 1952; Jaeger & Pelloni, 1950; Pirila & Kilpio, 1949; Pirila, 1953; Skog & Thyresson, 1952). The severity and stage of skin disease may accelerated with increased uptake of particles and chemicals through the barrier layer of skin (Chen *et al.*, 2008; Drexler *et al.*, 1994). Therefore, if cement is left over the skin throughout the working day, rather than being washed off at intervals, the risk of contact sensitization to cement dust will be increased ever than former (Salem *et al.*, 2008). Employees simply cannot rely on pain or discomfort to alert them of cement burns or dermatitis because that might not cause immediate pain or discomfort. The disease become significant after a long run when much damage has already been done. Cement burns can get worse even after ending the skin contact with cement (Adkins, 1993).

In a developing country like Bangladesh, over population, illiteracy and poverty are three major features governing the country and playing a vital role in industrial sectors (Lorraine, 1975; IDLC Finance Limited, 2011). In maximum cases, workers who start to work in industries are unskilled as they are not provided with sufficient training and safety equipment. Which are specially designed for workers to wear and stay protected in work environment hazard. A full-set of personal protective equipment (PPE) includes head, eye, hand, foot protectors, life jackets, safety armors and suitable working uniform except some adaptations (Health & Safety Executive, 1992; Legislation.gov.uk, 2015) But our labor population stay far behind from all these provisions and every year these workers are experiencing thousands of acute and chronic diseases which might have prevented by adapting proper PPE (LaBar, 1990, cited in Akbar-Khazadeh *et al.*, 1995). These health

statures have a major effect on the national economy as they cause loss of productive hours, skilled manpower, money as compensation and in addition sufferings to the victims and their family etc. These are the matter of facts why Bangladesh is still struggling with its working manpower even in 21st century. Perhaps enough attention has not paid on this regard because labor is found cheap here. But this should not be the proper case, rather workers should be provided with proper health trainings and safety by the policy makers and industrialists of the country, which might lead to reduced number of occupational diseases. Evidences of such studies are not well concluded in Bangladesh, particularly for cement sectors yet, for this regard an intense interest was paid in current study to focus on the deprived, unaware and unconscious worker population working in cement factories in Bangladesh. Intention was to know their exact health condition specially converging on cement related burns and dermatitis on purpose of bringing change in the policy making of this country. The objective of this study was to find out the skin morbidity profile of cement factory workers and also to find out the hideous causes those are responsible for such situation.

Materials and Methods

Study Area: A cement industry named, *Shun Shing* Cement Mills Ltd. (Labanchara, Rupsha, Khulna; Fig.1) from south-west geographical region (lat: 22°78' N and long: 89°58' E) of Bangladesh was taken in consideration as study site. This industry is one of the leader industries in the cement market of Bangladesh and recently has been expanding business massively in the ill-developed south-western region of Bangladesh. So, this industry drew a major attention to perform a study on worker's health conditions.

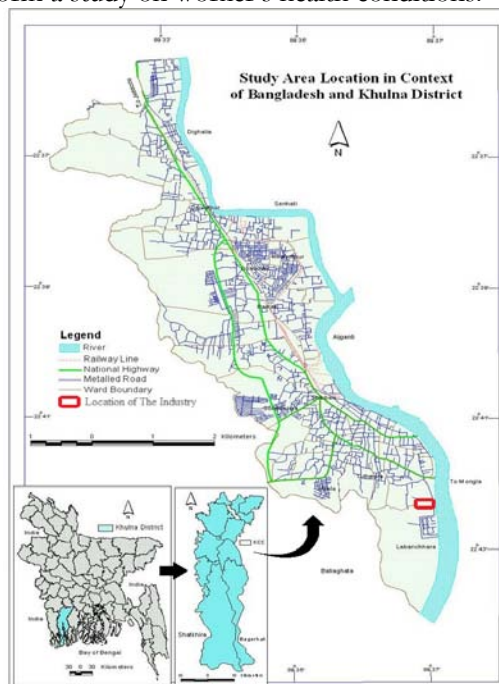


Fig. 1: Location of *Shun Shing* Cement Mills Ltd., Labanchara, Rupsha, Khulna in Southwest

Methods: An interviewer administered questionnaire was used for recording occupational contact dermatitis of workers under this study. The questionnaire was structured and based on standard questionnaires used in different studies (Susitaival *et al.*, 2003; Sana *et al.*, 2013; Mehraj *et al.*, 2013; Colls, 2001). Both structured and open-ended questions about demographics, work history, use of personal protective equipment, smoking habit, skin problems, worker's practice and knowledge of sanitation and safety etc. were included in questionnaire. 80% proportional of the total employee, 50 sample subjects¹ were selected for interviews (Kothari, 1990). Study subjects were categorized into four age groups, 15 – 25, 25 – 35, 35 – 45, 45 – 55 years and all were male. All the age groups were educated up to primary level but further higher education was entirely nondescript. As the industry just had established 3 years ago, this study added previous cement industry related job with the present as the total service in cement job. High number of workers found to be working around 5-10 years in cement related active exposure sites. Such as, mill house where highest 67% adolescent and young aged groups were recorded working. Maximum workers in adolescent and young aged groups had regular smoking habit, that was not much frequent in other groups.

Results

Skin dermatitis: The statistical and graphical summary of Portland cement related dermatitis and skin problems of the research subjects are presented in Fig 2. The incidence of irritant dermatitis caused by skin contact with Portland cement was very high among workers of all ages. Such as 93%, 88%, 100% and 80% of ailments found in age range 15 – 25, 25 – 35, 35 – 45 and 45 – 55 years respectively (Fig. 2-b). But the occurrence of allergic dermatitis caused by cement sensitization was medium in adolescent and young-aged whereas was higher in adult and elderly subjects (67% and 60% in specific age group respectively). Genesis of caustic cement burn was reportedly higher in age range 25 – 35 and 15 – 25 years with a score of 40% and 46%, which was considerably lower in adult or elders. A peak of 80% of workers reported to have skin disease episodes of at least 3 to 6 times in a year (Fig. 2-a). Even a notable amount of (22% of the total workers) study subjects claimed to have different types of skin diseases even more than 6 times in a year. Very few workers had reported 1 or 2 times skin disease attack in a year. All the workers were traced to suffer from multiple dermatitis (Fig. 2-c), of which rash and scaling were the highest (in 93% and 87% of cases respectively). Moderate to high association of other dermatitis like redness, blisters, bumps and fissures were also very common. Just like the type of occurrence, place of association was also in multiple body parts (Fig. 2-d). Approximately 100% of the recruited workers had multiple skin disease association and all of them complained hand as the most associated place for skin dermatitis. A significant amount of them also mentioned forearm, leg, foot and neck as the place of association for dermatitis (71%, 56%, 40% and 38%, respectively).

¹ $n = \frac{z^2 p \cdot q \cdot N}{e^2 (N-1) + z^2 p \cdot q}$; Where, N = total population =80; n = sample size; p = sample proportion =80%=.8; q = 1- p; z = standard variate at a given confidence level =1.96 at 95% confidence level; and e = acceptable error (the precision) =0.07
Outcome sample, n= 48.4727≈50

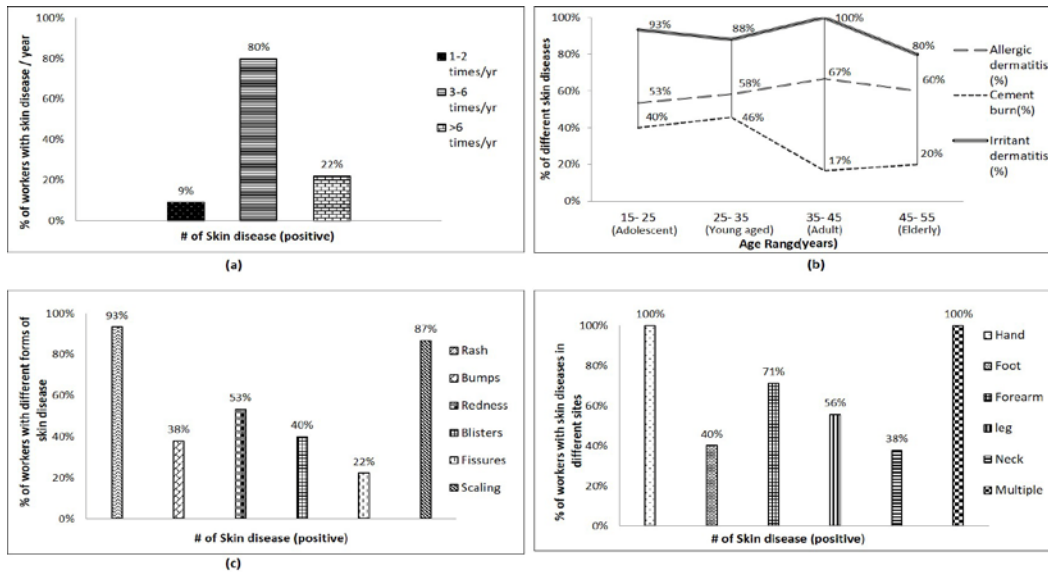


Fig. 2: Skin dermatitis in workers, (a) frequency of occurrence of skin disease; (b) association of skin dermatitis; (c) type of dermatitis; (d) place of association

At last a comparison was made between the records of skin disease positive workers and the workers listed previously as smokers in Fig. 3(a). The outcome revealed that, in each age range more than 50% of workers were smokers who had association with different skin diseases. Record of these diseased-smokers are 71%, 62%, 67% and 50% from age group 15 – 25, 25 – 35, 35 – 45, 45 – 55 years, respectively.

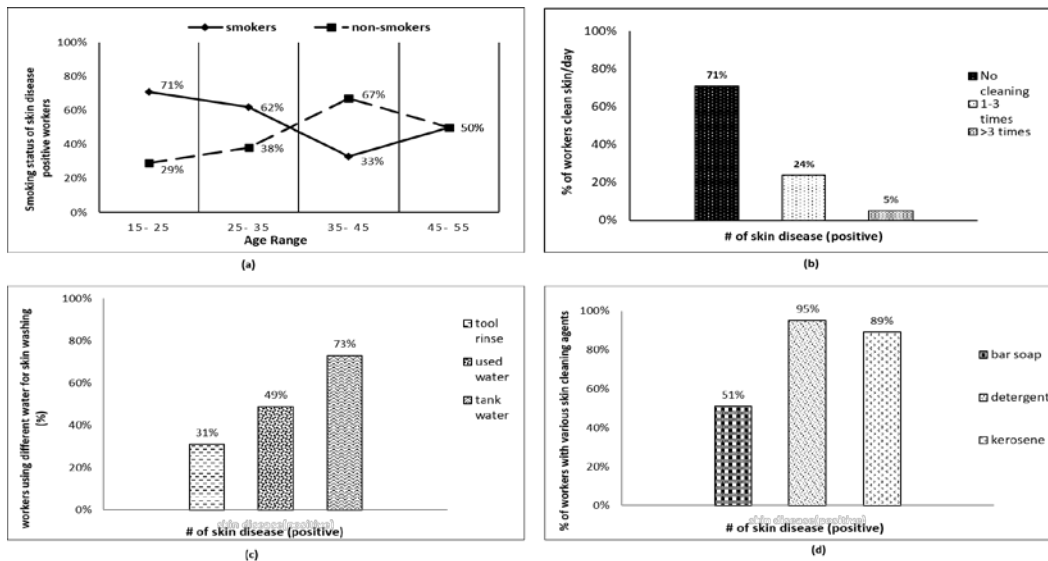


Fig. 3: (a) Smoking status of skin disease positive and their sanitation practices; (b) frequency of skin cleaning; (c) skin cleaning water; (d) skin cleaning agent

Sanitation practices: The statistical and graphical summary of sanitation related washing facilities and practices followed by workers in this Portland cement industry is summarized in Fig 3. Majority of the workers (71%) were reported not to wash any of their body parts if they were exposed to cement dust or wet cement (Fig. 3-b). Very few of them used to wash their body parts at not more than 1 to 3 times/day (24%). Whereas, very negligible number of workers said of cleaning body parts more than 3 times/day (13%). Usually, workers were using tank water (73%) for skin cleaning (Fig. 3-c). But, many of them were spotted to use water, which had been used before in some cement processing or cooling purposes (49%) or tool rinsing (31%). Workers followed multiple washing agents for cleaning their skin and body parts (Fig. 3-d). But most of the study subjects mentioned detergent (95%) and kerosene (89%) as washing agents and others were using bar soap (51%).

Practice of using personal protective equipment (PPE): As presented in Table 1, most of the workers did not have practice of using proper set of Personal Protective Equipment (PPE) in the working environment. A little number, mostly the adult (50%) and elderly (40%) workers covered their face with cotton cloth while working. Few others were wearing helmet (adult = 50% & elderly = 40%) or boot (adult = 50% & elderly =40%). On the other hand, the adolescents and young-aged subjects were not maintaining cotton mask, helmet or boot. The most soar thing was that, no other component of PPE like glove, goggles, dress code, respiratory mask or protective cream were maintained here by the workers.

Table 1: Use of full set of PPE by the workers

Age Range		15 – 25 (adolescent)	25 – 35 (young-aged)	35 – 45 (adult)	45 – 55 (elderly)
Population		15	24	6	5
Cotton cover	n	2	3	3	2
	%	13	13	50	40
Helmet	n	2	4	3	2
	%	13	17	50	40
Boot	n	2	3	3	2
	%	13	13	50	40
No full set of PPE	n	15	24	6	5
	%	100	100	100	100

Correlation and coherence of skin dermatitis: To find out the relationship and overall coherence among different skin dermatitis and other probable factors, Pearson’s correlation matrix was formulated and summarized in Table 2 and Table 3.

Table 2: Correlation matrix of different skin dermatitis and possible responsible facts

	<i>Exposure to dust</i>	<i>Smoking</i>	<i>Mill House</i>	<i>Unloading</i>	<i>Pack house</i>	<i>Job period (5-10 yrs)</i>	<i>Work hour (</= 8 hrs)</i>	<i>PPE</i>
Irritant dermatitis	0.323*	0.330*	0.505**	-0.181	0.099	0.310*	-0.065	0.445**
Allergic dermatitis	0.711**	0.324*	0.426**	-0.400**	-0.125	0.711**	0.082	0.427**
Cement burn	0.260	0.388**	0.104	0.108	-0.247	0.505**	0.289*	0.491**

*significant at the 0.05 level (2-tailed); ** significant at the 0.01 level (2-tailed).

Table 2 reveals that irritant dermatitis is strongly positively correlated with exposure to cement dust ($r=0.323, p<0.05$), mill house work ($r=0.505, p<0.01$), job length ($r=0.310, p<0.05$) and smoking ($r=0.330, p<0.05$). Similarly, this study has found allergic dermatitis is significantly positively correlated with exposure to cement dust ($r=0.711, p<0.01$), working in mill house ($r=0.426, p<0.01$), job length ($r=0.711, p<0.01$) and smoking ($r=0.324, p<0.05$). Statistical analysis also indicated that cement burn is significantly positively correlated with job length ($r=0.505, p<0.01$), working for a long period in day ($r=0.289, p<0.05$) and smoking ($r=0.388, p<0.01$). It is also evident from the analysis that use of PPE has significant positive correlation with irritant dermatitis ($r=0.445, p<0.01$), allergic dermatitis ($r=0.427, p<0.01$) and cement burn ($r=0.491, p<0.01$). Statistical analysis also revealed that frequency of skin disease/year is strongly correlated with frequency of skin cleaning/day ($r=0.404, p<0.01$), skin washing water ($r=0.489, p<0.01$) and skin cleaning agent ($r=0.753, p<0.01$) (Table 3). Skin sites associated with different dermatitis also has significant correlation with skin cleaning/day ($r=0.327, p<0.05$) and skin washing water ($r=0.446, p<0.05$).

Table 3: Correlation matrix of different skin dermatitis and possibly responsible sanitization facts

	<i>Frequency of skin disease/ year</i>	<i>site of skin with skin disease</i>
Frequency of skin cleaning/ day	0.404**	0.327*
Skin washing water	0.489**	0.346*
Skin cleaning agent	0.753**	0.008

* significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed)

Discussion

Current study found different valuable information about the employees of this particular cement industry, their scale of involvement at industry, regular dust exposure etc. These unavoidable facts might be playing a significant role for the association of skin dermatitis.

Though the industry had a very limited number of worker, but most of them were young, unaware labor population. Moreover, high illiteracy rate acts as catalyst to their unconsciousness about own work and health status. As a significant cause of skin ailment, study marked less to no knowledge of sanitation and safety maintenance among the participants. Generally, they were unwilling or unaware to wash the cement exposed body parts even once while working. Due to poor educational and industrial guideline knowledge (Manjula *et al.*, 2013; Mwaiselage *et al.*, 2006) the employees hardly knew using tool rinse or used water with corrosive washing agents detergent or kerosene might harm previously affected skin. As a drawback, majority of the young population were suffering from cement burn because they were notorious enough to clean their boots or any body parts even a scoop of wet caustic cement fall on them. Study mostly found association of irritant dermatitis and allergic dermatitis in an episode of 3 – 6 times in a year. Such skin disease association was prominent in young person rather than matured adult or elderly one. These young population were mostly working in the main production house or mill house which involves activities requiring dry and wet caustic cement contact. As a result, they were significantly more affected with rash, redness and scaling, mostly in hand, forearm and leg. Certain skin disease profile among the working manpower has been demonstrated absolutely by the incessant occupational cement dust exposure over the working hour for a lengthy period (Chen *et al.*, 2008; Mathias & Morrison, 1988; Vaaranen *et al.*, 1983, as cited in Kanerva *et al.*, 1988). Although such skin complaints have been the commonest among the cement industry workers worldwide (Ashish *et al.*, 2011; Llachapelle, 1986) but this particular cement industry workers of south-western Bangladesh would be fallen within the worst case scenario. Because study found over 80 percent of skin morbidity with a certain high frequency per year. Moreover, smoking habit exacerates worker's susceptibility to skin disease association. Because smoking contributes to the increased uptake of heavy trace elements into human body from the contaminated surroundings or working environment which escalate cell damage and blood-metal load (Chen *et al.*, 2008; Chuang *et al.*, 1999). The most noteworthy thing was, workers had a poor practice of using personal protective equipment (PPE) which had a significant correlation in forming skin dermatitis (Breisch, 1989, as cited in Akbar-Khazadeh *et al.*, 1995). If the workers would have used different safety equipment like gloves, respiratory mask, boot, helmet, dress code, goggle or skin protective cream they might not have been suffering from all these skin diseases at this rate (Chen *et al.*, 2008; LaBar, 1990, cited in Akbar-Khazadeh *et al.*, 1995). Statistical analysis has also approved that working in cement industry with no PPE for a long period of time, where minimum or no practice of sanitation is present, have a strong significant chance of forming different skin diseases.

Conclusion

The study demonstrated high prevalence of skin diseases among the workers in this particular cement industry at south-west region of Bangladesh and younger were more affected than the adult. Allergic contact dermatitis and irritant dermatitis, specified to rash, scaling, redness mostly in hand, forearm and leg were generally happening illness by 3-6 times per year. Working many years in extensive cement dust contaminated environment is the main reason of skin disease and gets devastated by smoking habit. Less to no knowledge

of safety training, poor sanitation and hygiene maintenance and uncommon use of PPE act as the catalyst in provoking the worst skin disease profile in workers.

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References

- Adkins C. (1993). Occupational safety and health. In Burke T, Tran N, Roemer J, & Henry C (eds). *Regulating risk: The science and politics of risk*. Washington, DC: ISIC press, 23-24.
- Akbar-Khanzadeh, F., Bisesi, M. S., & Rivas, R. D. (1995). Comfort of personal protective equipment. *Applied ergonomics*, 26(3), 195-198.
- Ali, M. M., & Al-Kodmany, K. (2012). Tall buildings and urban habitat of the 21st century: A global perspective. *Buildings*, 2(4), 384-423.
- Ashish, T., Yogesh, P., Niraj, P. & Bharat, B. (2011). Prevalence of skin morbidity among construction site workers working at Vadodara. *Health Line*, 2, 31–33.
- Aydin, S., Aydin, S., Croteau, G., Sahin, I., & Cital, C. (2010). Ghrelin, nitrite and paraoxonase/arylesterase concentrations in cement plant workers. *Journal of Medical Biochemistry*, 29(2), 78–83.
- Health & Safety Executive. (1992). Personal protective equipment at work. *Personal protective equipment at work regulations 1992: Guidance on regulations*. HM stationery office.
- Chen, C. J., Shih, T. S., Chang, H. Y., Yu, H. S., Wu, J. De, Sheu, S. C., Wu, C. E. & Chou, T. C. (2008). The total body burden of chromium associated with skin disease and smoking among cement workers. *Science of the Total Environment*, 391(1), 76–81. <<https://doi.org/10.1016/j.scitotenv.2007.11.011>>
- Chuang, H. Y., Lee, M. L. T., Chao, K. Y., Wang, J. D., & Hu, H. (1999). Relationship of blood lead levels to personal hygiene habits in lead battery workers: Taiwan, 1991-1997. *American Journal of Industrial Medicine*, 35(6), 595–603.
- Colls, J. (2001). Monitoring ambient air quality for health impact assessment. *Environmental Conservation*, 28(1), 86–94.
- Denton, C. R., Keenan, R. G., & Birmingham, D. J. (1954). The chromium content of cement and its significance in cement dermatitis. *Journal of Investigative Dermatology*, 23(3), 189–192. .
- Drexler, H., Göen, T., & Angerer, J. (1994). Carbon disulphide. II: Investigations on the uptake of CS₂ and the excretion of its metabolite 2-thiothiazolidine-4-carboxylic acid after occupational exposure. *International Archives of Occupational and Environmental Health*, 67(1), 5–10.
- Frey, E. (1952). Contribution to the evaluation of the jaeger calibichromate test on cement. *Dermatology*, 105(4–5), 244–250.
- IDLC Finance Limited. (2011). *Research report: Cement sector of Bangladesh*. Dhaka, Bangladesh.

- Jaeger, H., & Pelloni, E. (1950). Epicutaneous tests with dichromates, positive in cement eczema. *Dermatology*, 100(4-6), 207-216.
- Kanerva, L., Estlander, T., & Jolanki, R. (1988). Occupational skin disease in Finland an analysis of 10 years of statistics from an occupational dermatology clinic. *International Archives Of Occupational and Environmental Health*, 60(2), 89-94.
- Kothari, C. (1990). *Research methodology: Methods and techniques* (2nd ed.). New Delhi: New age international (p) limited.
- Legislation.gov.uk. (2015). *Health and safety at work etc. act 1974*. [online] <<http://www.legislation.gov.uk/ukpga/1974/37>>
- Llachapelle, J. M. (1986). Industrial airborne irritant or allergic contact dermatitis. *Contact Dermatitis*, 14(3), 137-145.
- Loraine, J. A. (1975). Overpopulation, under development and poverty—the main issues of world population. *International Journal of Environmental Studies*, 8(1-4), 83-89.
- Manjula, R., Praveena, R., Clevin, R. R., Ghattargi, C. H., Dorle, A. S., & Lalitha, D. H. (2013). Effects of occupational dust exposure on the health status of portland cement factory workers. *International Journal of Medicine & Public Health*, 3(3), 192-196.
- Mathias, C. G. T., & Morrison, J. H. (1988). Occupational skin diseases, United States: Results from the bureau of labor statistics annual survey of occupational injuries and illnesses, 1973 through 1984. *Archives of Dermatology*, 124(10), 1519-1524.
- Mehraj, S. S., Bhat, G. A., Balkhi, H. M., & Gul, T. (2013). Health risks for population living in the neighborhood of a cement factory. *African Journal of Environmental Science and Technology*, 7(12), 1044-1052.
- Meo, S. A. (2004). Health hazards of cement dust. *Saudi Medical Journal*, 25(9), 1153-1159.
- Mwaiselage, J., Moen, B., & Bråtveit, M. (2006). Acute respiratory health effects among cement factory workers in Tanzania: An evaluation of a simple health surveillance tool. *International Archives of Occupational and Environmental Health*, 79(1), 49-56.
- Peck, S. M. (1945). A discussion of the commoner industrial dermatoses. *Industrial Medicine and Surgery*, 14(12), 960-964.
- Perez-Grau, L. (2009). *The urban health effects and impact of anthropogenic and natural air pollution* (Doctoral thesis). Available from Universitat Pompeu Fabra thesis database.
- Pirila, V. (1953). On the role of chrome and other trace elements in cement eczema. *Acta Dermato-Venerologica*, 34(1-2), 136-143.
- Pirila, V. & Kilpio, O. (1949). On dermatoses caused by bichromates. *Acta Dermato-Venerologica*, 29(6), 550-563.
- Pope III, C. A., & Dockery, D. W. (2006). Health effects of fine particulate air pollution: Lines that connect. *Journal of the Air & Waste Management Association*, 56(6), 709-742.

- Salem, S., Genaidy, A., Albers, J., Shell, R., Sobeih, T., & Rinder, M. M. (2008). Use and acceptability of reduced-weight Portland cement bags in masonry construction: An observational pilot study. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 18(3), 253–269.
- Samet, J. M., Dominici, F., Zeger, S. L., Schwartz, J., & Dockery, D. W. (2000). The national morbidity, mortality, and air pollution study, part I: Methods and methodologic issues. *Research Report (Health Effects Institute)*, 5–14.
- Sana, S., Bhat, M. B., & Balkhi, H. M. (2013). Health risks associated with workers in cement factories. *International Journal of Scientific and Research Publications*, 3(5), 1–5.
- Skog, E., & Thyresson, N. (1952). The occupational significance of some common contact allergens. *Acta Dermato-Venerologica*, 33(1–2), 65–74.
- Susitaival, P., Flyvholm, M. A., Meding, B., Kanerva, L., Lindberg, M., Svensson, A. & Olafsson, J. H. (2003). Nordic occupational skin questionnaire (nosq-2002): A new tool for surveying occupational skin diseases and exposure. *Contact Dermatitis*, 49(2), 70–76. <<https://doi.org/10.1111/j.0105-1873.2003.00159.x>>
- Vestbo, J. & Rasmussen, F. V. (1990). Long-term exposure to cement dust and later hospitalization due to respiratory disease. *International Archives of Occupational and Environmental Health*, 62(3), 217–220.
- Zelege, Z. K., Moen, B. E. & Bråtveit, M. (2011). Lung function reduction and chronic respiratory symptoms among workers in the cement industry: A follow up study. *BMC Pulmonary Medicine*, 11(1), 50. <<https://doi.org/10.1186/1471-2466-11-50>>