

Construction Chemical Irritant Exposure Controls in Relation to Prevalence of Symptoms of Skin Diseases in Zambia

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ABSTRACT

Construction is one of the most hazardous industries as some key construction materials such as wet concrete and paints expose workers to chemical irritants that are harmful. Studies have shown that exposure to chemical irritants causes symptoms of skin diseases that impact workers and projects negatively. Therefore, it is important to understand how hazard control methods relate with the prevalence in order to effectively control the chemical irritant hazards to protect workers. This paper investigates the controls for chemical irritant exposures in relation to prevalence of symptoms of skin diseases in the construction industry in Zambia. A cross-sectional study was conducted using an interview-based questionnaire on 100 workers. Bricklayers, carpenters, batchers, tilers, demolition workers, painters and labourers were purposively sampled on a road and building projects. Data was quantitatively analysed using Package for Social Science through descriptive and inferential statistics. Pearson Chi-square, degree of freedom, confidence interval of 95% and level of significance of $p < 0.05$ were used. The significant results were correlated to find the type of relationship. Wearing of gloves, gumboots, work suits and washing of hands were the common controls used on both sites. There was a negative relationship between controls used and prevalence of symptoms of skin diseases.

The more suitable and well fitted gloves, gumboots and worksuits were worn the lesser the prevalence of symptoms of skin diseases. Also, there was a positive relationship between the nature of hands after work and the prevalence of symptoms of skin diseases. The dirtier the hands the higher the prevalence of symptoms of skin diseases. Consequently, the more effective the controls, the less the prevalence of symptoms of skin diseases. Hence, it is paramount to for all stakeholders to use a combination of all control methods in the hierarchy of controls to mitigate the chemical irritants so as to significantly reduce the prevalence of symptoms of skin diseases. This may improve the workers' health and increase project productivity as workers would be fit for work.

Keywords: Chemical Irritants; Construction; Controls; Skin Diseases; Symptoms

Introduction

Construction is one of the most hazardous industries with activities which expose workers to harmful chemical irritants. According to Mashqoor et al. [1], during construction activities, chemicals may come in contact with the workers' skin and may cause symptoms of skin diseases such as dermatitis. Example of hazardous yet staple material in construction for concrete is cement. Cement contains potassium dichromate which causes skin diseases like dermatitis [2].

Skin diseases effect workers' health and negatively impact projects in terms of lost man hours. A study by Tente [3] showed that one of the common ill-health in construction in Zambia was skin disease. The cause of the skin disease was due to exposure to chemical irritants. Moreover, the recent findings show that the construction workers in Zambia are exposed to high levels of silica dust which are more than 0.05mg/m³ OSHA PEL and chemical irritants [4,5]. Therefore, it is important to reduce exposures to safeguard the health of workers and mitigate impacts the symptoms of diseases have on the projects.

Tente and Mwanaumo [6] suggested that there is a relationship between levels and period of exposure to chemical and the occurrence of skin diseases. The longer the period and higher the levels of exposure to chemical irritants the higher the probability of occurrence of skin diseases [6]. Cement causes burning sensation and pain when it comes in to contact with the skin of workers [7]. This may also cause irritant contact dermatitis [8]. According to Shah and Tiwari [9], some of the skin symptoms are friction callosities, fissured and scaly skin. The symptoms of skin diseases can be mitigated by controlling exposures to chemical irritants. There are five known methods of control called hierarchy of controls. The methods are elimination, sub-

stitution, engineering control, administrative control and the use of personal protective equipment (National Institute of Occupational Safety and Health [NIOSH], [10]. Table 1 shows the type of control, description and example of control. The methods in the hierarchy of control are ranked from the most effective to the less effective. The most effective method is elimination despite it being uncommon in the construction industry as it involves complete removal of hazards. Some construction staple materials cannot be completely avoided but may be mitigated by the use of other methods in the hierarchy of controls [11].

Table 1: Hierarchy of Controls of Chemical irritants.

Hierarchy	Method	Description	Example
Most Effective	Elimination	Preventing the skin from being in contact with chemicals by completely removal of the chemical irritants.	Removal of painting activity by using face brick.
	Substitution	This is replacing the hazardous chemical or method with a less hazardous chemical or method one.	Using ready mix concrete instead of manual mixing on site [13].
	Engineering Control	This involves the removal of exposure to hazards from the source [14] or avoiding the contact of the chemical irritants with the workers' hands.	Use of the trowel machine to finish wet concrete.
	Administrative	Use of training to reduce exposure and to prevent skin diseases [1].	Encouraging workers to wash hands [8] and apply petroleum jelly to moisturize, heal and restore the skin wounds [15].
Less Effective	PPE	Equipment that is worn by workers to reduce exposure to hazards	The full PPE consists of a work suite or overall, safety shoes or boots, reflector vest, hardhat, safety goggles, respirators or dust masks, gloves and earplugs [5].

The use of PPE is less effective method. Despite the fact that PPE is less effective, many construction stakeholders consider it as the means to workplace hazards [12]. Each individual method apart from elimination method, may not be effective enough to completely remove the hazard. Therefore, the occupational health and safety professionals and stakeholders should understand that the workplace hazards can only be effectively controlled to levels that may not endanger the health of workers by the use of the hierarchy of controls by a combination of control methods [11-15]. Although the use of PPE is less effective, the lack of suitable and well fitted PPE may lead to is high prevalence of dermatitis [1]. Also, Bedoya-Marrugo et al. [16] found that 70% of workers did not use PPE which meant exposure to high levels of chemical irritants and eventual development of symptoms of skin diseases. Similarly, Shah and Tiwari [9] in their research found that 50% of the workers did not use PPE and the 45.2% of those who wore PPE still developed symptoms of skin diseases. This would have been that the PPE was unsuitable and that PPE alone cannot reduce exposure to chemical irritants effectively to levels that are not harmful to the skin of workers.

Materials and Methods

The process included collecting primary data and secondary data. The primary data was collected from the questionnaire survey. The secondary data was from the literature review on previous studies

that are in line with chemical irritant exposures and control in construction. A sample of 100 workers was randomly selected from a population of 1,012 workers from a road project and a building project to represent the construction industry. The sampled workers were bricklayers, batchers, tilers, demolition workers, painters, handymen, road construction workers and carpenters as these were found to be more exposed to chemical irritants according to literature. The sample size of 100 was selected using a conventional method at 10% of the population [17]. The 100 questionnaires were equally distributed between a road and building projects to get experiences from both sectors. Consent certificates were signed by all participants and all ethics according to the Natural and Applied Sciences Research Ethics Committee (NASREC) requirements were followed. An interview-based questionnaire was adopted to quickly collect data to avoid delays on the activities the workers were performing. As such the data was collected in two months, May and November 2021.

The collected data was quantitatively captured in excel and analysed using IBM Statistical Package for Social Science (SPSS) version 1.0.0.45. through descriptive and inferential statistics. Pearson Chi-square and degree of freedom were used to test the relationship of variables. The confidence interval of 95% and level of significance of $p < 0.05$ were considered as statistically significant. The significant results were correlated to find the type of relationship.

Results and Discussion

The common controls for chemical irritants on both sites were PPE (gloves, gumboots and worksuits) washing of hands and application of hand cream. The results of the common controls were assessed in detail and cross-tabulated with the symptoms of skin diseases as shown in Table 2. The results with ρ -values of less than 0.05 were frequency of wearing gloves, provision of gumboots and worksuits and nature of hands after work (dirty hands) were statistically sig-

nificant therefore there was a relationship. The three characteristics were correlated for the type of relationship with the prevalence of the symptoms of the skin diseases. The results of the type of relationship are shown in Table 3. From the positive relationship between nature of hands after work and prevalence of symptoms of skin diseases, meant that the dirtier the hands are after work, the more prevalent the symptoms of skin diseases. This result is similar to findings by Tente et al. [5] and Timmerman [8] who suggested that the construction workers are exposed to higher levels of chemical irritants.

Table 2: Chemical Irritant Controls in relation to Symptoms of Skin Diseases.

Characteristics	Freq (%)	Symptoms of Skin diseases					ρ -value
		Itchy Hands N (%)	Scaly Hands N (%)	Vesicles on Hands N (%)	Red bumps N (%)	None N (%)	
Type of Gloves							
Disposable	4	0(0)	2(50)	0(0)	0(0)	2(50)	0.245
PVC	19	1(5)	5(26)	3(16)	2(11)	8(42)	
Cotton latex coated	29	5(17)	9(31)	1(3)	8(28)	6(21)	
Leather	6	0(0)	2(33)	1(17)	2(33)	1(17)	
No gloves	42	4(10)	21(50)	6(14)	6(14)	5(12)	
Frequency of Wearing Gloves							
Always	56	1(7)	1(7)	2(14)	2(14)	8(58)	0.019
Sometimes	14	5(11)	17(38)	3(7)	10(22)	10(22)	
I don't wear	30	4(10)	21(50)	6(15)	6(15)	4(10)	
Provision of Gumboots & Worksuits							
Yes	76	4(5)	29(38)	8(11)	15(20)	20(26)	0.034
No	24	24	6(25)	3(13)	3(13)	2(8)	
Adequacy of Washing Facilities							
Yes	89	9(10)	34(38)	9(10)	15(17)	22(25)	0.402
No	11	1(9)	5(46)	2(18)	3(27)	0(0)	
Frequency of Hand Washing							
Once at work	29	2(7)	15(51)	5(17)	5(17)	2(17)	0.435
Once at home	2	0(0)	1(50)	0(0)	1(50)	0(0)	
Sometimes at work	1	0(0)	1(100)	0(0)	0(0)	0(0)	
Several Times at work	68	6(7)	35(43)	8(10)	15(18)	18(22)	
Frequency Hand Cream							
Once per day	82	2(7)	15(51)	5(17)	5(17)	2(17)	0.336
Once per week	1	0(0)	0(0)	0(0)	0(0)	1(100)	
Once in a while	3	0(0)	1(33)	1(33)	1(34)	0(0)	
Not used before	14	4(29)	3(21)	2(14)	2(14)	3(22)	
Nature of Hands after work							
Very dirty	89	9(10)	39(43)	9(10)	16(18)	16(18)	0.034
A bit dirty	9	0(0)	0(0)	2(22)	2(22)	5(56)	
Not dirty	2	1(50)	0(0)	0(0)	0(0)	1(50)	

Table 3: Type of Relationship between Variables and Prevalence of Symptoms of Skin Diseases.

	Prevalence of the symptoms of the skin diseases		
	N	Sig. (2-tailed)	Pearson Correlation
Nature of hands after work	100	0.018	0.237
Wearing of gumboots and worksuits	100	0.009	-0.262
Frequency of wearing gloves	100	0	-0.347

There was a negative correlation between prevalence of symptoms of skin disease and, the wearing of gumboots and worksuits (-0.262) and the frequency of wearing gloves (-0.347). The negative relationship meant that as the wearing of gumboots and worksuits, and the frequency of wearing gloves increased, the prevalence of symptoms of skin diseases reduced. This meant that the workers were more exposed to chemical irritants and eventually develop symptoms of skin diseases. Therefore, the implication of the negative correlation results is that when the quality and suitable PPE (gloves, gumboots and worksuits) is worn, the exposure to chemical irritants is reduced and eventually less prevalence of symptoms of skin diseases. The findings are comparable to Mashqoor et al. [1], Bedoya-Marrugo et al. [16], Shah and Tiwari [9] who found that the lack and not wearing of suitable PPE led to high levels of exposure to chemical irritants and were related to prevalence of symptoms of skin diseases.

Conclusion and Recommendations

The study revealed that there was a relationship between the controls used for chemical irritants and the prevalence of the symptoms of the skin diseases. The more frequent the suitable, quality and well-fitted gloves, gumboots and worksuits were worn by workers, the less the prevalence of symptom of skin diseases. This meant that the workers were more exposed to chemical irritants and eventually developed symptoms of skin diseases. Moreover, the dirtier the hands after work the higher the prevalence of symptoms of skin diseases. It is recommended that all methods in the hierarchy of controls are well utilized in combination to effectively reduce the exposure of chemical irritants and eventually reduce the prevalence of symptoms of skin diseases in the construction industry. In addition, all construction stakeholders should participate and uphold the use of all the control methods in the hierarchy of controls to effectively reduce exposure to chemical hazards in construction. This would help to safeguard the health of workers and lessen the negative impact the symptoms of skin diseases have of the projects. In addition, the effective control of hazards improves safety culture, boost worker's morale and improves their productivity.

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