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Knowledge on prevention of occupational health hazards and utilization of safety measures among construction trade workers in Colombo District

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Abstract

Introduction: The construction industry includes extension, alteration or erection of a building which is fabricated on-site as a whole or portion or a preliminary work preparation such as pile driving. It is one of the most hazardous industries in the world. Thus, prevention of such health hazards is highly recommended to be practised by all construction workers to reduce any untoward occurrences in the construction sites.

Objectives: To describe the knowledge on prevention of occupational health hazards and utilization of safety measures among construction trade workers in a selected construction site in the district of Colombo

Methods: A cross-sectional descriptive study was conducted among 290 male construction trade workers from a construction site in the district of Colombo using stratified random sampling with probability proportionate to size (PPS) method considering the job categories to divide the strata. Data were collected using an interviewer-administered questionnaire. The knowledge and safety measures were assessed based on a pre-determined scoring system. Two categories of knowledge and safety measures were compared with selected socio-demographic and work-related factors using bivariate analysis. Prevalence odds ratio (prev. OR) with 95% confidence interval (CI) were calculated and p value 0.05 was considered as statistically significant.

Results: The response rate was 94.5% (n=274). The mean age was 35.69 (SD=8.71) years. A majority (n=214; 78.1%) was educated up to grade 1-5. A fewer construction trade workers (n=12; 4.4%) received the training on safety practices. The majority had unsatisfactory knowledge (n=228; 83.2%) while 89.8% (n=246) had unsatisfactory safety practices. Good knowledge was seen in construction workers who received training on safety measures (OR=71.42; 95% CI=28.93-89.52; p=0.001). In contrast, satisfactory practices were seen among workers who possessed a higher level of education (Grade 6-GCE Ordinary Level) (OR=4.52; 95% CI=1.77-11.56; p=0.001).

Conclusions & Recommendations: Both knowledge and safety practices were unsatisfactory among construction trade workers in the selected construction site in the district of Colombo. Less-educated workers and those who did not receive training on safety practices were more vulnerable to hazards, implying the need of regular supervision and monitoring.

Keywords: *construction trade workers, construction industry, safety practices*

Introduction

Construction industry is an energetic and high-pressured industry in the world, yet it has been termed as a potentially high-risk environment where various forms of hazards are laden (1). Approximately 350 million world population are directly involved in construction industry and the number is increasing at a rapid rate (2). A higher number of fatalities were reported in the construction industry worldwide, representing 19.9% of all worker deaths in 2016 (3). Further, mortality due to occupational hazards in the construction industry varies across the countries and is estimated at 11 and 26 deaths per 100 000 workers in the United States and Myanmar, respectively (4-5). The Bureau of Labour Statistics reports that the construction industry experienced work-related diseases and injuries were responsible for the deaths of 1.9 million people in 2016 (3). Further, the impact of occupational hazards confronted by construction workers in developing countries is 10-20 times higher than those in developed countries (6). Thus, emphasis on preventive measures, such as short and long-term training as well as encouragement to use safety tools can effectively decrease the prevalence of occupational injuries both in developed and developing countries (7).

Construction trade workers are assigned to specific roles such as structural, finishing or mechanical, however some workers perform more than one specific type of activity (8). Thus, they are commonly exposed to several hazardous work environments such as work at height, excavations, power tools and equipment, confined spaces, electricity, noise and dust. The most common causes of death are falls from elevations, motor vehicle crashes, electrocution, machines and struck by falling objects (9). Thus, prevention and protection from health hazards in such settings is highly recommended to be practised by all construction workers.

The construction industry provides a high contribution to Gross Domestic Product in Sri Lanka with an increasing rate over the past few years (10). Further, Sri Lanka is considered one of the most vulnerable countries for occupational hazards and is ranked at a low level for occupational safety and health (OSH) performance due to lack of improvement measures (11). The workforce is around 8 million, yet around 4 000 occupational injuries are reported annually in Sri Lanka, while the number of working days lost due to accidents is estimated to be around 600 000 every year (12). In 2018, only 256 fatal and 358 non-fatal occupational accidents were reported in Sri Lanka, however this evidence is lacking (13). It is clear that many workplace accidents occur at an unacceptably elevated rate and most of them are preventable. Therefore, the contractors and employers should confirm the safety practices such as the availability of adequate welfare facilities, use of personal protective equipment (PPE) and monitoring of the general health and safety of the employees (14). Nowadays, there are many construction sites in the district of Colombo. Thus, it is important to identify the gaps in knowledge and practices on the prevention of occupational hazards among construction trade workers and the findings of this study will help to redesign the safety guidelines, reform the basic training curriculums and expand the training programmes to improve the knowledge and practices on prevention of occupational health hazards and to describe the knowledge on prevention of occupational health hazards and utilization of safety measures among construction trade workers in a selected construction site in the district of Colombo.

Methods

A descriptive cross-sectional study was conducted in a building construction site in the district of Colombo. Data were collected from January to December 2019. The sample consisted of male construction trade workers above 18 years of age, with work experience for more than six months at the selected construction site. Those on medical leave for more than five days or who were engaged in job-related activity outside the construction site during the data collection period were excluded from the study. Stratified random sampling with PPS was used considering structural, finishing, mechanical and others as strata to select the sample. The required sample was calculated as 290 to detect an estimated

proportion of 'satisfactory practices' of 78% on safety measures of occupational hazards among constructional workers in a study done in Yangon Region, Myanmar; Z value of 1.96; precision of 5% and non-response of 10% (15-16).

Data were collected using a pre-tested interviewer-administered questionnaire. It consisted of socio-demographic data, work-related data (job category, work experience and training received on safety measures), and knowledge on prevention of occupational health hazards and safety measures. Prior to data collection, informed written consent was obtained. Data collection was done during weekends and public holidays to minimize interference with their work schedules.

Data analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) software (version 23). In the knowledge component, correct responses were given +1 mark while the 'incorrect' and 'do not know' responses did not carry any marks. All marks were amalgamated into a total knowledge score (score range: 0-16). Scores above 50% were categorized as 'good knowledge' and others as 'unsatisfactory knowledge'. Responses on practice were also allocated marks, with +1 for those practising and zero marks for not practising and don't know responses. The mean of each component related to practices was calculated. Total score above 50% obtained for all practices was categorized as 'satisfactory' and others as 'unsatisfactory'. Bivariate analysis was conducted to assess the relationships of selected socio-demographic and work-related variables with good knowledge and satisfactory practices, using prevalence odds ratio (prev. OR) with 95% confidence interval (CI).

Results

The study was conducted among 274 construction trade workers (response rate of 94.5%). The majority were structural workers (43.4%), educated up to Grade 5 (89.8%) and drawing a monthly family income of Rs. 20,001-30.000 (32.5%). Almost 96% of the workers had not received any training on safety practices (Table 1).

Knowledge on prevention of occupational hazards among workers

Most of the workers incorrectly answered that working on a ladder is safer than using scaffolding or an elevating work platform (75.2%); the frequency of injuries due to the use of scaffolds is less in the construction sites (83.9%); wearing goggles is important while on ground and supplying materials to the man working above (65.0%); and that sawing, sanding and drilling do not generate harmful dust (81.0%) (Table 2). Total knowledge score was normally distributed with mean of 43.6 (SD=10.3). The majority (n=228; 83.2%) had unsatisfactory knowledge on prevention of occupational hazards.

Occupational safety practices among workers

Nearly half (n=139) of the workers did not make sure that foam work is securely erected before its use, while 63.9% (n=175) did not follow instructions of a competent person when using scaffolds and 66.4% (n=182) not examine the ladder before using it. Alarmingly, 119 (43.4%) used metal ladders even with nearby electrical installations, while 192 (70%) did not work with secure fencing. Strikingly, 61 (22.3%) workers ensured that the dangerous part of the machine is installed with a guard before operating a machine. In contrast, 38.0% (n=104) did not check the electric tool, its plug and connecting cable before using it. Only 20.8% (n=57) wore suitable eye protectors, 29.9% (n=82) ear protectors in areas with high noise level, while 63.15% (n=173) wore safety shoes and 71.2% helmets (n=195). Most of the construction trade workers reported 'unsatisfactory safety practices' related to working in foam work (73.7%) and fencing on workplace (96.0%) (Table 3). 90% (n=246; 89.8%) had 'unsatisfactory' level of safety practices.

Factors associated with knowledge on prevention on occupational hazards and safety practices

A significantly higher proportion of workers with 'satisfactory knowledge' was seen among those who

had received training on safety practices (prev. OR=71.4; 95% CI=28.93-89.52). No such relationship was seen with age, level of education and work experience (Table 4). A significantly higher proportion of workers with 'satisfactory practices' was seen among those well-educated (prev. OR=4.52; 95% CI=1.77-11.56). There was no relationship with age, working experience and knowledge on prevention on occupational hazards (Table 4).

Table 1: Distribution of the workers by their socio-economic characteristics (N=274)

Socio-economic and educational background	No.	%
Age group (years)		
18-27	71	25.9
28-35	60	21.9
36 and above	143	52.2
Monthly family income (Rs.)		
Less than 20,000	36	13.1
20,001-30,000	89	32.5
30,001-40,000	97	35.4
40,001-50,000	18	6.6
>50,000	34	12.4
The highest level of education		
Never schooled	32	11.7
Grade 1 to 5	214	78.1
Grade 6 to GCE Ordinary Level*	28	10.2
Job category		
Structural workers	119	43.4
Finishing workers	57	20.9
Mechanical workers	68	24.8
Others	30	10.9
Work experience		
Less than 2 years	20	7.3
2 to 10 years	186	67.9
More than 10 years	68	24.8
Received training on safety practices		
Yes	12	4.4
No	262	95.6

*General Certificate of Education

Table 2: Knowledge on prevention of occupational hazards among workers (N=274)

Characteristics	Correctly answered No. (%)	Incorrectly answered No. (%)	Do not know No. (%)
Knowledge on prevention of occupational hazards while working in a height			
Every ladder must be tied and securely positioned at the correct angle	205 (74.8)	43 (15.7)	26 (9.5)
The side rails of the ladder should extend at least 900 mm (3 ft) above the landing and be secured at the top	158 (57.7)	76 (27.7)	40 (14.6)
Working on a ladder is safer than using scaffolding or an elevating work platform	42 (15.3)	206 (75.2)	26 (9.5)
A single ladder must not be more than 6.0 feet high	136 (49.6)	89 (32.5)	49 (17.9)
The frequency of injuries due to use of scaffolds is less in the construction sites	31 (11.3)	230 (83.9)	13 (4.8)
The outer edge and the ends of a working platform should be protected by a rigid guard rail	148 (54.0)	92 (33.6)	34 (12.4)
Scaffold platforms must be fully planked	51 (18.6)	44 (16.1)	179 (65.3)
Falls due to unstable footing, unguarded holes and slips off scaffolding and ladders are common	83 (30.3)	63 (23.0)	128 (46.7)
Knowledge on PPE, physical and ergonomic hazards			
Wearing goggles is important while on ground and supplying materials to the man working above	71 (25.9)	178 (65.0)	25 (9.1)
Repetitive work can lead to muscle pain	212 (77.4)	10 (3.6)	52 (19.0)
Some wood / cement dusts are carcinogenic	116 (42.3)	85 (31.0)	73 (26.7)
Sawing, sanding and drilling do not generate harmful dusts	26 (9.5)	222 (81.0)	26 (9.5)
Knowledge on PPE, physical and ergonomic hazards			
Head, eyes, ears, and hands must be adequately protected while working	123 (44.9)	20 (7.3)	131 (47.8)
Fire extinguishers must always be kept invisible and difficult to access	35 (12.8)	221 (80.6)	18 (6.6)
During working in the confined spaces silent, invisible hazards could be occurred	57 (20.8)	178 (65.0)	39 (14.2)
Deaths are usually the result of oxygen-deficient, toxic, or combustible atmospheres in the confined areas	21 (7.7)	235 (85.7)	18 (6.6)

Table 3: Occupational safety practices among workers (N=274)

Safety practices	Unsatisfactory		Satisfactory	
	No.	%	No.	%
Working in foam work	202	73.7	72	26.3
Work on a scaffold	45	16.4	229	83.6
Use of a ladder	47	17.2	227	82.8
Use of lifting appliances	184	67.2	90	32.8
Fencing on the workplace	263	96.0	11	4.0
Operating a machine	72	26.3	202	73.7
Safe workplace	154	56.2	120	43.8
Using an electrical tool	42	15.3	232	84.7
Use of an excavation	78	28.5	196	71.5
Use of PPE	127	46.4	147	53.6

Discussion

In this study, 16.8% of the workers were showing overall 'satisfactory' knowledge on prevention of occupational hazards, which is higher than 4.3% (95% CI=2.0-8.1%) reported in a study conducted in Myanmar in a similar population (4). However, a study conducted in Lagos State in Nigeria reported 'good' knowledge among 61.9% of construction workers (17), while another study in India reported 75% to have 'average' knowledge, 24% 'poor' knowledge and 1% 'good' knowledge on occupational hazards (18). This might be due to differences in the tool used to assess knowledge. Further, the present study comprised predominantly older persons with primary education as their highest education level. In contrast, other studies have shown a predominance of younger workers in the construction field (16-17). This could be attributed to the high level of physical labour required in construction industry, yet in Sri Lanka, most of the less educated young males are engaged in other fields such as driving three-wheel taxis.

Most of the construction trade workers admitted that dust, heat, noise, stress, prolonged work and manual handling or lifting were risks associated with construction industry in the current study. This is in line with empirical reports that workers in construction industry have a high risk of occupational injuries or work-related illness resulting from high risk of exposure to different levels of hazards (12, 19).

Only 10% had satisfactory use of safety practices in the present study. In comparison, 77.7% (95% CI=71.3-83.3) was shown to have such practices in a study conducted in Myanmar (4), which may be due to mandatory rules of wearing safety boots, apron and safety helmet while at work. Surprisingly, 53.6% workers (n=147) were using PPE in the current study, in contrast to a study conducted in Nigeria that observed unsatisfactory practices as high as 99.3% (17). This could be due to the difference in the study setting, nature of work and type of workplace hazards. Nevertheless, in the current study, a lesser proportion was wearing suitable eye protectors (20.8%), ear protectors in areas with high noise level (29.9%) and mask when working in a dusty environment (23.7%). In support of these findings, previous studies have found poor compliance and lack of regularity in the utilization of safety measures among construction workers especially in the developing countries due to lack of firm policies on occupational health and safety (20). The non-use of safety devices among workers can be attributed to forgetfulness or beliefs that they were not convenient or necessary. This highlights an important area on occupation and safety intervention to advocate for a policy that would facilitate periodic monitoring and

Table 4: Factors associated with knowledge on prevention of occupational hazards and safety practices (N=274)

Factors	Satisfactory No.	%	Unsatisfactory No.	%	Prev. OR*	95% CI	Significance
Knowledge on prevention of occupational hazards	**n=46**		**n=228**				
Age (in years)							
18-27[b]	15	21.1	56	78.9			
28-35[b]	12	20.0	48	80.0	1.24	0.89-3.21	p=0.1
36-66[a]	19	13.3	124	86.7	1.00		
Highest level of education							
Grade 6 to GCE O/L[b]	7	25.0	21	75.0	1.77	0.7-4.44	
Grade 1 to 5[a]	37	17.3	177	82.7	1.00		p=0.2
No schooling[a]	2	6.2	30	93.8			
Training on safety measures							
Received	11	91.7	1	8.3	**71.42**	**28.93-89.52**	
Not received	35	13.4	227	86.6	1.00		**p=0.001**
Working experience							
Less than 5 years	21	19.8	85	80.2	1.45	0.78-1.97	
5 years or above	25	14.8	143	85.2	1.00		p=0.29
Occupational safety practices	**n=28**		**n=246**				
Age (in years)							
36-66[b]	19	13.3	124	86.7	2.08	0.90-4.78	
28-35[a]	6	10.0	54	90.0	1.00		p=0.08
18-27[a]	3	4.2	68	95.8			
Highest level of education							
Grade 6 to GCE O/L[b]	8	28.6	20	71.4	**4.52**	**1.77-11.56**	
Grade 1 to 5[a]	16	7.5	198	92.5	1.00		**p=0.001**
No schooling[a]	4	12.5	28	87.5			
Training on safety practices							
Received	2	16.7	10	83.3	0.55	0.11-2.65	
Not received	26	9.9	236	90.1	1.00		p=0.45
Working experience							
Less than 5 years	15	14.1	91	85.9	1.85	0.65-1.91	
5 years or above	13	7.7	155	92.3	1.00		p=0.45
Knowledge on prevention on occupational hazards							
Unsatisfactory	25	11.0	203	89.0	0.57	0.16-1.96	
Satisfactory	3	6.5	43	93.5	1.00		p=0.36

[a, b] Rows were amalgamated to form one category for calculation of p value: * Prev. OR=prevalence odds ratio

supervision at both local and national level in the construction industry regarding compliance with occupation health and safety.

The study found out that knowledge on prevention of occupational hazards was associated with the workers attending occupational skill training in the present study (p=0.001). There was no association found with age, the highest level of education and working experience (p>0.05). These findings were inconsistent with the study conducted in Myanmar (4), where statistically significant associations of age (p=0.04), educational status (p=0.001), type of work (p=0.013), type of worker (p=0.016) and attending skill training (p=0.002) were noted with total knowledge. Thus, training on safety measures should be launched to improve the knowledge related to occupational safety at construction sites. Further, satisfactory level of safety practices was seen among the well-educated (Grade 6 to GCE O/L) constriction trade workers compared to those less-educated (up to grade five and not attended school) (p=0.001), thus making less educated construction workers more vulnerable to not adhering to the safety practices in the present study. Therefore, the administrators and supervisors should pay attention to those at-risk workers through regular supervision and monitoring to improve their safety.

There were few limitations in the present study. The cross-sectional study conducted was not powered enough to detect some of the factors associated with knowledge on prevention of occupational injuries and safety practices. Further, the safety measures of workers were not obtained by observation, thus leading to an over-representation of the safety practices by most workers who usually do not practise them as required. Also, the interval estimates of the main outcome variables were wide, indicating the chance factor interfering with the results. However, when the sample size is re-calculated for the percentage obtained from the current study, the sample required was 155, indicating adequate power.

Conclusions & Recommendations

The majority had unsatisfactory knowledge on prevention of occupational hazards and safety practices. Less educated workers were more vulnerable to unsafe practices, highlighting the need for regular supervision and monitoring. While training on safety measures should be provided to every worker to improve the knowledge, strict policies and standard regulation and monitoring are recommended to ensure and improve the health and safety at organizational level and among local building contractors. There is also a need for health promotion and campaign to sensitize and enlighten workers on health risks attributed to poor utilization of PPE.

Public Health Implications

- Inspection of the construction sites and supervision of the staff is needed regularly to strengthen the safety practices at the construction sites. It can be conducted by the medical officer of health (MOH) at regional level. Further, MOH should ensure that each construction site worker receive training on safety measures at regular intervals.

Author Declarations

Competing interests*:* The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethics clearance was obtained from the Ethics Review Committee of the National Institute of Health Sciences, Kalutara. Written authorization was obtained from the Regional Director of Health Services (RDHS), Colombo, project manager at the construction site and informed written consent from the participants.

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Author contributions*:* KK was the principal investigator of the study. All authors were involved in conceptualizing, data collection, data analysing and interpretation of data. KK was involved in drafting the manuscript. All authors revised it critically for intellectual content and gave final approval.

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