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Utilization of Personal Protective Equipment in Construction Industry of Nepal

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Abstract

Construction industry is one of the most dangerous industries worldwide. Use of personal protective equipment reduces injuries associated with it. This study has been undertaken to find out safety improvement measures and enforcement of statutory provisions available for safety practices, to analyze the current issues regarding application of PPE and to identify key factors preventing effective use of safety wears in construction industry of Nepal. The methodology adoptedconsists of comprehensive review of literature and questionnaire survey.100 sets of questionnaires to the professionals and 385 to the site operatives were administered. The collected data were analyzed using relative mean score and independent samples test and then ranked as per their significance. This study concluded that routine check of scaffold and ladder, in house safety training, daily consciousness of safety practice,etc. willimprove workers' safety practices. Wearing PPE can help protect from work related injuries, feeling responsible for wearing PPE all the times, asking supervisors for provision of appropriate and adequate PPE but the management has not maintained sufficient stock of appropriate safety wears are the current issues regarding application of PPE. Based on the result of Independent Samples T-test, safety wears are not comfortable to wear with, operatives' engagement in improper conduct that could endanger their safety, ineffective communication between safety managers and workers are the major factors preventing effective use of safety wears.

Keywords: Construction, Occupational hazard, Safety practices, Statutory provisions, Personal protective equipment.

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1. Introduction

Construction industry is one of the largest industries with many challenges of health and safety risks at site. It is high accident prone industry. It is estimated that more than 10 million workers receive injuries during one year throughout the world. Compared with the manufacturing sector which averages 60-80 accidents per 1000 workers, construction averages 160-250 accidents per 1000 workers (Manandhar, 2016). A report by World Health Organization (WHO, 2002) identifies the risks faced by workers in the construction industry, detailing the work-related diseases and injuries which have been aggravated, accelerated or exacerbated by workplace exposure and which may impair working capacity.It is estimated by the International Labor Organization (ILO) that 10% of the gross domestic product (GDP) in the developing countries is lost as a result of occupation accidents and health hazards (ILO, 2007). Nepalese Construction Industry contributed around 10 to 11 percentages to GDP andit uses around 35 percent of government budget. It is estimated that this sector is creating employment opportunities to about one million people so it generate employment next to agricultural sector in the country. Similarly about 60 percentages of the nation's development budget is spent through the use of contractors (Federation of Contractors Association of Nepal). GDP from Construction in Nepal increased to 50878.40 NPR Million in 2017 from 45987.40 NPR Million in 2016. GDP From Construction in Nepal averaged 35869.50 NPR Million from 2001 until 2017, reaching an all-time high of 50878.40 NPR Million in 2017 and a record low of 27225.05 NPR Million in 2001.

The concept of occupational safety and health is still new in Nepal. To save the workers from the occupational diseases and accident proper use of personal protective equipment are recommended. But in the workplace neither the workers or their union activists nor the management are serious on this issue. Most of the women workers have little knowledge about the safety equipment which can cause accidents and injuries at the workplace. In some workplace management has provided some of the equipment (mask, eye glass, gloves, boot, safety belt, helmet, head cap, air plug/ mask/mug, apron, etc.) but mostly workers disliked to use them or misused pretending differently. Nonetheless, workers have an obligation to use and take care properly the PPE provided by the management. As a result, administration did not provide such PPEs later on. Employers also accepted that they could not compel to their workers to use necessary safety equipment due to various reasons. In some of the establishment management had given cash to the workers to purchase certain protective tools that needed for their safety. Despite the managements' encouragement, workers did not use and not interested to use them. In some workplace, workers blamed that the given PPE were sub-standard, it created a lot of problems rather than save them. So, they were not interested to use them. It is also difficult to obtain exact figures of individuals involved in an accident due to lack of documented information or records from either the project managers or relevant government agencies. Due to these factors, contractors sometimes compromise the safety of their workers by failing to provide them with proper PPEs or adhere to OSHA, 2007 on safety of construction workers (Gautam and Prasain, 2011).

Accidents are financially, physically and emotionally costly to individual workers, their families, their organizations and the nation as whole. On June 17, 2017 four workers went missing in river diversion tunnel in Arun III due to collapse of tunnel, and they were rescued after 39 hours and a worker who drove concrete mixer truck, died and two other workers injured in an accident inside tunnel construction site at Upper Tamakoshi on November 4, 2016 (Poudyal, 2018). These risks can be minimized by use of personal protective equipment if properly selected and worn by workers (Kirenga, 2004). Creating a safe and healthy workplace is therefore crucial hence occupational health and safety is important to everyone at workplace (Kirenga, 2004). Personal Protective Equipment (PPEs) plays a prominent role in ensuring overall health and safety on construction sites. PPEs includes the clothes offering protection against the weather which are intended to be worn or held against a person at work and which provides protection against risks to his health or safety (OSHA, 2007).This study will provide a guideline in future efforts for parties interested in improving present situation as well as informative and organized literature on PPE for those who wish to further research on this topic. The literature reviewed in this study serves as an organized body of knowledge that the parties engaged in construction sites can utilize in providing personal protective clothing as well as theoretical framework to incorporate into the construction sites. This study outlines the benefits of adopting workers safety practices, this not only motivates construction operatives but it is directly proportion to levels of productivity. The

results and recommendations derived from this study avails useful information to construction stakeholders for use of PPE and thus helps the policy makers or trainers to plan and implement the effective PPE program as a vital part of construction safety to avoid the loss of accidents, injuries and fatalities in different types of construction industry. The research objectives include:

- To find out the safety improvement measures and the enforcement of statutory provisions available for safety practices in construction industry of Nepal.
- To analyze the current issues regarding application of Personal Protective Equipment at construction workplaces.
- To identify the key factors preventing effective use of safety wears by workers in construction site of Nepal.

2. Literature Review

2.1 Situation Analysis on Status of OSH and Availability of PPE in Nepal

Awareness of workers about occupational safety and health depends on the nature of workplace. In all the workplace under study the workers had some knowledge of OSH though it varied greatly from one establishment to another. Informal sector workers have little knowledge compared to the formal sector. On an average only about 10 percent women have slight knowledge on OSH in Kathmandu valley where such knowledge is insignificant outside the valley despite various efforts made by the government, trade unions and employers. Among them majority have got the knowledge from training conducted by government, GEFONT as well as NTUC (I)/ GEFONT Board while others have got it from replication from the co-workers. This shows, replication part is very weak in all the workplace in Kathmandu Valley while it is almost nil in outside valley. The major cause having no knowledge regarding OSH is lack of interest of the workers themselves which is accepted by the workers, union activists and their management. The key concern of the workers is only on the immediate monetary benefits. Almost all employers have also only little knowledge on this issue and are not much cooperative to replicate the knowledge to the workers on the one hand and on the other women workers could not manage time to replicate the knowledge gained from the OSH training due to work burden in the house and outside. The situation demands intensive training and awareness campaign covering both the workers and management in each workplace. Taking in confidence to both the stakeholders (employees and employer) provision of replication should make mandatory to the workers who benefited from it. At the same time environment for replication should be created to all.

Workers has blame that their management is not cooperating to disseminate their knowledge obtained from training at the workplace but management had denied to accept the blame regarding workplace situation and OSH though they accept there is a lot to improve to reach the ISO standard. Some of them committed to provide logistics in the factory to organize training without hampering the work but denied to provide allowance to the trainee workers.The situation of OSH in Nepal has been improving over the time because government as well as trade unions has been conducting OSH related training programs to make the workers more aware on the issue. In a few sectors, some of the international project have also started intervention to improve the OSH situation.To save the workers from the occupational diseases and accident proper use of personal protection equipment are recommended. But in the workplace neither the workers or their union activists nor the management are serious on this issue. This research revealed that most of the women workers have little knowledge about the safety equipment which can prevent from diseases and accidents at the workplace. In some workplace management has provided some of the equipment (mask, eye glass, gloves, boot, safety belt, helmet, head cap, air plug/ mask/mug, apron, etc.) but mostly workers disliked to use them or misused pretending differently. Nonetheless, workers have an obligation to use and take care properly the PPE provided by the management. As a result administration did not provide such PPEs later on.

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Lack of awareness and felt-inconvenience by the workers are the major causes not using them as reported by the workers themselves. The PPEs should comply with the standards set by the competent authority and ergonomic principle into account. But as of the workers and trade union activists, most of the equipment provided to the workers are of low quality without any quality check and management is providing the same for all workers which are not practicable. This is partially accepted by the concerned management. In some of the enterprises workers said that they have demanded verbally for the necessary safety equipment with the management, but they get mixed response. In this connection while analyzing the 261 written demands submitted to the management by trade unions, only 9 percent are related directly or indirectly on OSH showing less preference on this issue. Workers of some enterprises said that they have no specific OSH related demand (medical treatment, ambulance facility, first aid, regular health checkup, sick leave, etc.) in their demand sheet but frequently they are verbally demanding (individually or in group) with concerned authorities in the establishment. Likewise, some of their demands are related to workplace improvement but the management did not fulfil, despite their assurance time and again. In some of the establishment workers union have demanded mainly preventive method where management has taken it positively and improving gradually. This situation indicates that OSH issue is not in the priority of the workers and their union where management is also not taking it seriously.

The workers working under the contractor are not receiving any such equipment and compelled to manage themselves when needed. As of the workers under such provision did not use the PPE because they could not afford them (Gautam and Prasain, 2011).

2.2 Factor Preventing Effective Use of Safety Wears on Construction Sites.

Several authors have worked on health and safety management on construction site, but adequate consideration have not been given to proactive measures of effective use of safety wears on workers wellbeing. This is due to its active role of modifying the behavior of workers which will reluctantly yield a greater influence towards improving safety behavior (Mat Zin and Ismail, 2011).Many factors have been considered why workers lack effective use of safety wears, though the cause of occupational accidents have been classified into unsafe conditions and unsafe behavior. Irizarry, Simonsen, and Abraham (2005) argued that contractors sometime overlook their workers from using safety wears because they perceived that its use could increase time taken by the workers to complete their daily output, which in turn impedes their productivity. Several problems were encountered in the safety practices; ignorance of workers on work procedures, lack of financial allocation for safety management, lack of awareness among workers, and language barrier between supervisors and workers. (Tan and Nadeera, 2014).

Based on the study conducted by Krishnamurthy (2006) on safety practices on high rise design and construction, the study established that workers ignorance, negligence, carelessness, over-confidence and workers disregarding proper use of safety wears were the major factors affecting safety practices. The study done by Okolie and Okoye (2012) provides a better understanding of risk perceptions, attitudes and safe/unsafe behavior of construction workers, managers' safety practices, preferences and the extent to which workers' attitudes and perception interface with culture, the use of improper safety wears contributed to high rate of accidents on construction sites. Umeokafor et al., (2014) stated that unemployment have made workers to disregarded compliance with safety practices by accepting risky jobs. Guldenmund, Cleal and Mearns (2013) noted that workers low wages and willingness to accept risky job as a means of survival remained the majors cause of accidents. Muhammad et al., (2015) argued that any attempt to implement health and safety programs on construction site would increase the overall cost of the projects.

2.3 Safety Improvement Measures and Control Systems in Construction Industry.

Issue of safety on construction project should be a concern to every construction participant, especially client and their representative need to avert the risk associated with their project right from the planning stage by adopting sustainable strategies and practices that will eliminate possibility of accident. Asfahl (1999) stated in order to prevent equipment failure from overuse and overload examination of scaffold, equipment and tools must be carried out before the start of work by Safety Manager. Abdelhamid and Everett (2000) added that continuous monitoring of safety wears compliance and framing comprehensive purchase policy are responsibility of safety department. The provision and effective use of safety wears is significant element in terms of accident prevention and control on construction sites. Agwu and Olele(2014) worked on fatalities in the Nigerian construction industry. The study supported the fact that, inclusion of positive safety culture by investing in machines and technology (socio-technical investments) in the Nigerian construction industry would resort in better safety performance of employees (reduced rate of unsafe acts) and the company (reduced rate of fatalities). This was conducted for a year with the respondents randomly selected from twelve construction industry, two each across the six geopolitical zones in Nigeria. There is significant different between poor safety culture and increased rate of fatalities in the Nigerian construction industry.

Agwu and Olele (2014) stated that regular staff training could improve hazard identification skills, engage managers and workers in addressing safety related issues, regular site safety, safety committees and eliminate potential workplace hazards and making hazard identification/reporting everyone's duties. In addition, Muhammad et al., (2015) suggested the following improvement strategies towards enhancing safety practices, they include: provision of health and safety policies, appointment ofSafetymanagers/supervisor on sites to ensure compliance and as well make provision for severe punishments should any contractors violate the said safety policy.

3. Research Methods

The Research include these phases: First phase is the topic selection along with identifying the problems, establishment of research objectives and development of research plan. Second phase focused on literature review. The various probable issues of PPE application, factors preventing use of safety wears, safety improvement measures and statutory provisions were listed reviewing the various literature and interviewing with the experts. In the third phase, questionnaire was designed and pilot test was done before field survey. In the fourth phase Cronbach's coefficient alpha was used to test the reliability of five points Likert scale during the pilot survey. The acceptable value is considered to be 0.7. Using SPSS, Cronbach's alpha was computed to be 0.87 in this questionnaire, so the questionnaire was used for primary survey. Fifth phase included a field survey, and questionnaire was distributed to the concerned professionals and site operatives. In sixth phase, questionnaires were checked, analyzed and ranking was done using Statistical Package for Social Science (SPSS) software. Last phase of the research is to draw conclusion and recommend accordingly.

In this research, the sampling is done by Random sampling technique in which the elements selected for the sample were chosen randomly by the researcher. In this research, respondents were chosen based on availability of the personnel and willingness to participate and with whom it is easy to communicate for sharing experiences and opinions.

Sampling and Population

For Site operatives

For populations that are large, Cochran (1963:75) developed the Equation to yield a representative sample for proportions.

$$N_0 = Z^2pq/e^2 \qquad (1)$$

Which is valid where N_0 is the sample size, e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. The value for Z is found in statistical tables which contain the area under the normal curve.

Assume there is a large population but that we do not know the variability in the proportion; therefore, assume p= 0.5 (maximum variability). Furthermore, suppose we desire a 95% confidence level and ±5% precision. The resulting sample size is calculated to be 385.

Professional respondents: According to Dr. Todd Grande. For finite population,

$$\textbf{Sample size (n)} = \frac{\frac{z^2.p(1-p)}{e^2}}{1+\frac{z^2.p(1-p)}{e^2N}} \qquad (2)$$

Confidence Level = 95%, Confidence interval =5%, P= 0.5, Error (e)= 4%= 0.04, Z= 1.96 for 95% confidence level, Population (N) = 120

Therefore, Sample size needed (n) = 100

Based on above calculations, 100 sets of questionnaires to the professionals and 385 sets of questionnaires to the site operatives involved in different construction workplaces were sent, totaling 485 sets of questionnaires. 485 sets of questionnaires were returned and analyzed justifying 100% response rate.

4. Data Analysis, Results And Discussions

Microsoft Excel and SPSS software were used to analyze data to find frequency distribution, mean values along with ranking of various factors. Independent samples test (Levene's test and T-test) was performed in SPSS software for comparison of mean scores between professional and site operative. Statistical test and methods as listed below was done in analysis:

- Relative Mean score method
- Independent samples t- test
- Reliability analysis

The formulae used for calculating Relative Mean score is:

$$\textbf{RM=} \frac{\sum_1^5(W.X)}{N.} \qquad (3)$$

Where,

RM = Relative mean

W = Weighting given to each factor by respondents and its ranges from 1-5 (5 points Likert scale)

X = Frequency of it response given for each factor

N = Total no. of participants.

From RM results, the ranking for different factors were determined.

Table 1 showed that 28(28%) of the professional respondents had Master's degree while 72(72%)had Bachelor's degree compared to 11(2.86%) of the site operatives had basic literacy course,236(61.30%) possess primary education,76(19.74%) secondary education and 62(16.10%) were uneducated. This justified that larger percentage of the respondents were highly qualified and knowledgeable enough to answer the questions. On the category of their operations, 76(76%) of the professional respondents were civil engineers, 3(3%) safety engineers, 1(1%) electrical engineer, 7(7%) geologists, 5(5%) accountant and 8(8%) managers while 136(35.32%)

of the site operatives respondents were mason, followed by 190(49.35%) labors,17(4.42%) heavy equipment operator, 35(9.09%) metal workers, 6(1.56%) electrician and 1(0.26%) others whose category of work was not mentioned.

Furthermore, it can be established that the respondents for this study have little knowledge of construction because 72% of the professional respondents have less than five years of working experience. Meanwhile, 66.23% of the site operatives have less than five years of experience.

Table 1: Demographic information of respondents

Professional			**Site Operatives**		
Demographic Information	**Freq.**	**Percentage**	**Demographic Information**	**Freq.**	**Percentage**
Gender			**Gender**		
Male	90	90	Male	349	90.65
Female	10	10	Female	36	9.35
Academic Qualification			**Academic Qualification**		
Bachelor (BE/BBS/BBA)	72	72	Basic literacy course	11	2.86
Masters	28	28	Primary education (class 1-8)	236	61.30
			Secondary education (class 9-12)	76	19.74
			None	62	16.10
Category of operation			**Category of operation**		
Civil engineer	76	76	Mason	136	35.32
Safety engineer	3	3	Labor	190	49.35
Electrical engineer	1	1	Heavy equipment operator	17	4.42
Geologist	7	7	Metal worker	35	9.09
Accountant	5	5	Electrician	6	1.56
Manager	8	8	Others	1	0.26
Age group of respondents			**Age group of respondents**		
16-20	-		16-20	81	21.04
21-25	16	16	21-25	61	15.84
26-30	56	56	26-30	80	20.78
31-35	19	19	31-35	66	17.14
36-40	6	6	36-40	56	14.55
41-45	-		41-45	18	4.68
46-50	-		46-50	12	3.12
above 50	3		above 50	11	2.86
Professional certificate			**Professional certificate**		
Yes	100	100	Yes	54	14.03
No	-		No	331	85.97
Years of experience			**Years of experience**		
1-5	72	72	1-5	255	66.23
6-10	24	24	6-10	99	25.71
11-15	1	1	11-15	22	5.71
16-20	0		16-20	4	1.04

above 20	3	3	above 20	5	1.30
Recent OSH training			**Recent OSH training**		
0-3 months	1	1	0-3 months	4	1.04
4-6 months	1	1	4-6 months	1	0.26
7-9 months	6	6	7-9 months		
10-12 months	2	2	10-12 months		
more than a year	16	16	more than a year	3	0.78

Source: Researcher's Field survey (2019) Professional (N= 100) Site operatives (N=385)

Objective one: Safety Improvement Measures and Enforcement of Statutory Provisions Available for Safety Practices in Construction Industry of Nepal

First part of first objective identified safety Improvement Measures available for safety practices in construction industry of Nepal on a Likert scale 1 –5 (1= not effective, 2= less effective, 3= sometimes effective, 4= moderately effective and 5= highly effective).

Table 2 showed results of an independent samples t-test conducted on safety improvement measures available for safety practice in construction sites between the scores of site operatives and professionals at significant level of 5% ($p \leq 0.05$).

There is significant difference on routine check on plant and equipment, professional respondents' (M = 3.870, SD= 1.331) and site workers (M = 3.527, SD = 1.315; t (483) = 2.316, p = 0.021 two-tailed). The magnitude of the differences in the means (mean difference = 0.343, 95% CI: 0.052 to 0.633). There was also significant difference on daily consciousness of safety practice on site, professional respondents' recorded (M = 4.170, SD= 1.146) as against site workers (M = 3.483, SD = 1.504; t (197.089) = 4.981, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference =0.687, 95% CI: 0.415 to 0.959). There was significant difference on routine health and safety briefing, professional respondents' recorded (M = 3.660, SD= 1.289) and site workers (M = 3.179, SD = 0.663; t (112.927) = 3.609, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.481, 95% CI: 0.217 to 0.745). There was significant difference on workers obtaining safety clearance before start of work, professional respondents' recorded (M = 3.900, SD= 1.185) and site workers (M = 3.335, SD = 1.233; t (483) = 4.115, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.565, 95% CI: 0.295 to 0.835). There was also significant difference on deduct wages of workers who failed to use PPE, professional respondents recorded (M = 3.270, SD= 1.462) and site workers (M = 2.514, SD = 1.356; t (483) = 4.884, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.756, 95% CI: 0.452 to 1.060). There was significant difference on inclusion of safety matters from the planning phase, professional respondents' recorded (M = 3.870, SD= 1.261) and site workers (M = 3.330, SD = 1.131; t (483) = 4.153, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.540, 95% CI: 0.285 to 0.796). There was also significant difference on improved site layout planning, professional respondents' recorded (M = 3.980, SD= 1.101) and site workers (M = 3.447, SD = 1.322; t (180.544) = 4.132, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.533, 95% CI: 0.279 to 0.788).

There is significant difference on setting safety guidelines into conditions of contract, professional respondents' recorded (M = 4.060, SD= 1.127) and site workers (M = 3.052, SD = 0.891; t (132.893) = 8.299, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 1.008, 95% CI: 0.768 to 1.248). There was significant difference on institute safety awards to motivation workers, professional respondents' recorded (M = 3.210, SD= 1.559) and site workers (M = 1.774, SD = 0.865; t (115.278) = 8.864, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 1.436, 95% CI: 1.115 to 1.757). There was significant difference on allocate budget for safety management, professional respondents' recorded (M = 3.790, SD= 1.209) and site workers (M = 3.366, SD = 1.251; t (483) = 3.038, p = 0.003 two-tailed). The magnitude of

the differences in the means (mean difference = 0.424, 95% CI: 0.150 to 0.698). There was significant difference on distribute pocket size copy of safety ethics to workers, professional respondents' recorded (M = 3.300, SD= 1.418) and site workers (M = 2.958, SD = 1.318; t (483) = 2.272, p = 0.024 two-tailed). The magnitude of the differences in the means (mean difference = 0.342, 95% CI: 0.046 to 0.637). There was also significant difference on proper waste management on site, professional respondents' recorded (M = 3.560, SD= 1.085) and site workers (M = 3.317, SD = 0.853; t (132.422) = 2.079, p = 0.04 two-tailed). The magnitude of the differences in the means (mean difference = 0.243, 95% CI: 0.012 to 0.474).

Table 2: Independent samples test on safety improvement measures needed for safety practices

Safety improvement measures	**Levene's Test for Equality of Variance**		**t- Test for Equality of Means**			**Mean**	**Std. Dev.**	**Mean diff.**	**95% confidence Interval of the diff.**	
	F	**Sig.**	**T**	**Df**	**Sig (2-tailed)**				**Lower**	**Upper**
Routine check on plant and equipment.	1.456	0.228	2.316	483.000	0.021*	3.870	1.331	0.343	0.052	0.633
			2.300	153.046	0.023	3.527	1.315	0.343	0.048	0.637
Use of safety audio, video and visual displaying gadgets on site	0.495	0.482	0.632	483.000	0.528	3.680	1.456	0.101	-0.213	0.414
			0.621	150.999	0.536	3.579	1.412	0.101	-0.220	0.422
Routine check of scaffold and ladder etc.	0.580	0.447	1.504	483.000	0.133	4.070	1.157	0.202	-0.062	0.467
			1.544	159.922	0.124	3.868	1.210	0.202	-0.056	0.461
Daily consciousness of safety practice on site	32.193	0.000	4.257	483.000	0.000	4.170	1.146	0.687	0.370	1.004
			4.981	197.089	0*	3.483	1.504	0.687	0.415	0.959
Routine health and safety briefing	107.776	0.000	5.158	483.000	0.000	3.660	1.289	0.481	0.298	0.664
			3.609	112.927	0*	3.179	0.663	0.481	0.217	0.745
Workers obtaining safety clearance before start of work	0.160	0.689	4.115	483.000	0*	3.900	1.185	0.565	0.295	0.835
			4.212	159.268	0.000	3.335	1.233	0.565	0.300	0.830
Deduct wages of workers who failed to use PPE	2.745	0.098	4.884	483.000	0*	3.270	1.462	0.756	0.452	1.060
			4.672	146.284	0.000	2.514	1.356	0.756	0.436	1.075
Inclusion of safety matters from the planning phase	0.163	0.686	4.153	483.000	0*	3.870	1.261	0.540	0.285	0.796
			3.897	143.107	0.000	3.330	1.131	0.540	0.266	0.814
Improved site layout planning	19.116	0.000	3.712	483.000	0.000	3.980	1.101	0.533	0.251	0.815
			4.132	180.544	0*	3.447	1.322	0.533	0.279	0.788
Setting safety guidelines into conditions of contract.	31.768	0.000	9.512	483.000	0.000	4.060	1.127	1.008	0.800	1.216
			8.299	132.893	0*	3.052	0.891	1.008	0.768	1.248
Institute safety awards to motivation workers.	137.003	0.000	12.237	483.000	0.000	3.210	1.559	1.436	1.205	1.667
			8.864	115.278	0*	1.774	0.865	1.436	1.115	1.757

Allocate budget for safety management	1.552	0.213	3.038	483.000	0.003*	3.790	1.209	0.424	0.150	0.698
			3.101	158.651	0.002	3.366	1.251	0.424	0.154	0.694
Conduct in-house safety training	12.783	0.000	-0.552	483.000	0.581	3.750	1.201	-0.058	-0.264	0.148
			-0.453	125.930	0.652	3.808	0.851	-0.058	-0.310	0.195
Provision of safety booklet in various languages	3.365	0.067	1.388	483.000	0.166	2.400	0.817	0.156	-0.065	0.376
			1.600	191.661	0.111	2.244	1.042	0.156	-0.036	0.348
Distribute pocket size copy of safety ethics to workers	1.252	0.264	2.272	483.000	0.024*	3.300	1.418	0.342	0.046	0.637
			2.177	146.550	0.031	2.958	1.318	0.342	0.032	0.652
Proper waste management on site	4.967	0.026	2.392	483.000	0.017	3.560	1.085	0.243	0.043	0.443
			2.079	132.422	0.04*	3.317	0.853	0.243	0.012	0.474

*Significant at 5% level ($p \leq 0.05$).

Table 3: Enforcement of statutory provisions for safety practices in construction site

Enforcement of statutory provisions		Professional		Site operatives		Overall	
		Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
1	Do you follow any regulation/ legislation in your construction site?	3.73	2	3.48	1	3.53	2
2	Do you find any safety inspector appointed in your company?	3	4	2.93	4	2.94	4
3	Have you make any arrangements for discussing health and safety matters with workers/ labors in your construction site?	3.3	3	3.03	3	3.09	3
4	Have you developed and carried out a site specific safety plan?	2.83	6	1.89	8	2.08	8
5	Do you have any first aid provision in your construction site?	3.97	1	3.48	2	3.58	1
6	Do you find any accidents due to lack of awareness about safety and health regulations stipulated?	2.55	9	1.85	9	1.99	9
7	Do you find any accidents due to inadequate supervision by supervisors in your construction site?	2.66	7	2.04	7	2.17	7
8	Is there any arrangement to monitor health and safety performance made in your company?	2.87	5	2.73	6	2.76	5
9	Do the inspector from GoN/ Labor office monitor the implementation of safety at construction sites?	2.55	8	2.78	5	2.73	6

Second part of first objective assessed respondents' level of agreement on enforcement of statutory provisions available for safety practices in construction industry of Nepal on a Likert scale 1 – 5 (1= No, 2= Occasionally, 3= Can't say, 4= Often, 5= Always).

Mean Item Score was used to rank respondents perception (Table 3).

Furthermore, Table 3 also showed that, three most frequently embraced parameters among the enforcement of statutory provisions listed on construction sites according to overall mean scores were: First aid provision (1st, 3.58), Follow any regulation/ legislation (2nd, 3.53) and discuss health and safety matters with workers (3rd, 3.09). Others parameters tested were not equally important as their mean scores below 3 points out of 5 points in the Likert scale.

Objective two: Current Issues Regarding Application of Personal Protective Equipment (PPE) at Construction Workplaces

Second objective of the study assessed respondents' level of agreement on current issues regarding PPE application in construction industry of Nepal using some selected safety performance criteria on a Likert scale 1 – 5 (1= No, 2= Occasionally, 3= Can't say, 4= Often, 5= Always). Mean Item Score was used to rank respondent's perception (Table 4).

Meanwhile, four most frequently embraced issues regarding application of PPE at construction workplaces according to overall mean scores were: wearing PPE can help protect from work related injuries (1st, 4.38), feel a responsible for wearing PPE at all times (2nd, 3.91), ask supervisors for provision of appropriate and adequate PPE when not provided (3rd, 3.07) and feel responsible for compliance with PPE (4th, 3.05).

Table 4: Current issues regarding PPE application at construction workplaces

PPE Issue Questions		Professional		Site operative		Overall	
		Mean	Rank	Mean	Rank	Mean	Rank
1	Do you feel you have a responsibility for compliance with PPE?	3.67	3	2.89	4	3.05	4
2	Do you feel you have a responsibility for wearing PPE at all times?	4.23	2	3.83	2	3.91	2
3	Are you responsible for purchasing, selecting, influencing the purchase or selection of PPE?	2.35	12	1.72	11	1.85	12
4	Do you ask your supervisors for provision of appropriate and adequate PPE when not provided?	3.56	4	2.94	3	3.07	3
5	Have you ever observed anyone in your organization failing to wear proper PPE in a situation when they should have been wearing it?	2.76	9	2.20	7	2.32	8
6	Do you personally believe that wearing PPE can help you protect from work related injuries?	4.63	1	4.32	1	4.38	1
7	Do you wear PPE as a habitual inclination?	2.96	8	1.88	9	2.10	10
8	Does management maintain PPE facilities on worksites (whether adequate or inadequate)?	3.2	6	2.35	6	2.53	7
9	Does management obtain a sufficient stock of carefully selected and appropriate PPE for each site?	3.11	7	2.46	5	2.59	6

10	Has management established an effective system for the issuance, recording and inspection of PPE and its replacement?	3.23	5	2.89	4	2.96	5
11	Does your company provide training on the use of PPE?	2.66	10	2.12	8	2.23	9
12	Is there a procedure to monitor the PPE brought on-site by subcontractor workers?	2.51	11	1.85	10	1.99	11

Objective three: Factors Preventing Effective Use of Safety Wears on Construction Sites

Third objective identified factors preventing site operatives from using safety wears on construction sites on a Likert scale 1 –5 (1= totally disagreed, 2= disagreed, 3= slightly agreed, 4= moderately agreed, 5= highly agreed).

Table 5 showed results of an independent samples t-test conducted on identifying factors preventing effective use of safety wears on construction sites between the scores of site operatives and professionals at significant level of 5% ($p \leq 0.05$).

Table 5: Independent Samples Test on identified factors preventing effective use of safety wears

Factors preventing effective use of safety wears on construction sites	**Levene's Test for Equality of Variance**		**t- Test for Equality of Means**			**Mean**	**Std. Deviation**	**Mean difference**	**95% confidence Interval of the diff.**	
	F	**Sig.**	**T**	**Df**	**Sig (2-tailed)**				**Lower**	**Upper**
Unethical practices of worker due to human attitudinal peculiarities and traditional believes.	98.638	0.000	9.272	483.000	0.000	2.410	1.173	0.810	0.638	0.982
			6.655	114.637	0*	1.600	0.638	0.810	0.569	1.051
Unsafe practices of worker due to religious assertions	2.695	0.101	0.680	483.000	0.497	2.190	1.022	0.084	-0.158	0.325
			0.715	165.199	0.476	2.107	1.112	0.084	-0.147	0.314
Willingness of the workers to meet their daily output	1.968	0.161	6.314	483.000	0*	3.510	0.969	0.671	0.462	0.880
			6.206	151.081	0.000	2.839	0.941	0.671	0.457	0.885
Inadequate engagement of Safety	3.190	0.075	0.847	483.000	0.398	3.180	1.104	0.099	-0.131	0.330
			0.813	146.987	0.417	3.081	1.031	0.099	-0.142	0.341
Managers and ineffective supervision on sites	47.083	0.000	0.763	483.000	0.446	2.950	1.290	0.080	-0.126	0.286
			0.589	120.296	0.557	2.870	0.816	0.080	-0.188	0.348
Insufficient instructions about the working condition and environment	42.863	0.000	-0.239	483.000	0.811	3.330	1.198	-0.023	-0.214	0.168
			-0.185	120.253	0.854	3.353	0.757	-0.023	-0.272	0.226
Safety wears is not comfortable to work with.	29.912	0.000	-9.256	483.000	0.000	3.080	1.292	-1.037	-1.257	-0.817
			-7.554	125.407	0*	4.117	0.907	-1.037	-1.309	-0.765

Workers inadequate or lack of understanding about the workplace safety rules	2.631	0.105	1.120	483.000	0.263	3.240	1.182	0.136	-0.103	0.375
			1.048	142.708	0.296	3.104	1.056	0.136	-0.121	0.393
Carelessness and over-confidence of workers	18.114	0.000	6.654	483.000	0.000	3.330	1.111	0.652	0.460	0.845
			5.511	126.925	0*	2.678	0.800	0.652	0.418	0.886
Lack of proper training on effective use of safety wears	2.137	0.144	5.601	483.000	0*	3.520	1.039	0.668	0.434	0.902
			5.693	157.762	0.000	2.852	1.069	0.668	0.436	0.900
Ineffective communication between health and Safety Managers and workers.	11.552	0.001	-0.318	483.000	0.751	3.450	1.086	-0.033	-0.238	0.172
			-0.282	134.989	0.779	3.483	0.884	-0.033	-0.266	0.199
Operatives' engagement in improper conduct that could endanger their safety	0.000	0.986	-3.410	483.000	0.001*	3.380	1.080	-0.433	-0.682	-0.184
			-3.527	161.523	0.001	3.813	1.144	-0.433	-0.675	-0.191
Lack of proper knowledge on the hazards management	0.602	0.438	2.236	483.000	0.026*	3.420	1.007	0.259	0.031	0.487
			2.277	158.141	0.024	3.161	1.038	0.259	0.034	0.484

*Significant at 5% level ($p \leq 0.05$).

There is significant difference on unethical practices of worker due to human attitudinal peculiarities and traditional believes on effective use of safety wears score, professional respondents' (M = 2.410, SD= 1.173) and site workers (M = 1.600, SD = 0.638; t (114.637) = 6.655, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.810, 95% CI: 0.569 to 1.051). In the same vein, there was significant difference on willingness of the workers to meet their daily output, professional respondents' recorded (M = 3.51, SD= 0.969) as against site workers (M = 2.839, SD = 0.941; t (483) = 6.314, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference =0.671, 95% CI: 0.462 to 0.880). There was significant difference on safety wears is not comfortable to work with, professional respondents' recorded (M = 3.080, SD= 1.292) and site workers (M = 4.117, SD = 0.907; t (125.407) = -7.554, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = -1.037, 95% CI: -1.309 to -0.765). There was significant difference on carelessness and over-confidence of workers, professional respondents' recorded (M = 3.330, SD= 1.111) and site workers (M = 2.678, SD = 0.800; t (126.925) = 5.511, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.652, 95% CI: 0.418 to 0.886). There was also significant difference on lack of proper training on effective use of safety wears professional respondents' recorded (M = 3.520, SD= 1.039) and site workers (M = 2.852, SD = 1.039; t (483) = 5.601, p = 0.000 two-tailed). The magnitude of the differences in the means (mean difference = 0.668, 95% CI: 0.434 to 0.902). There was significant difference on operatives' engagement in improper conduct that could endanger their safety, professional respondents' recorded (M = 3.380, SD= 1.080) and site workers (M = 3.813, SD = 1.144; t (483) = -3.410, p = 0.001 two-tailed). The magnitude of the differences in the means (mean difference = -0.433, 95% CI: -0.682 to -0.184). There was also significant difference on lack of proper knowledge on the hazards management, professional respondents' recorded (M = 3.420, SD= 1.007) and site workers (M = 3.161, SD = 1.038; t (483) = 2.236, p = 0.026 two-tailed). The magnitude of the differences in the means (mean difference = 0.259, 95% CI: 0.031 to 0.487).

Out of thirteen listed factors, top seven factors preventing effective use of safety wears based on overall mean score were: Safety wears is not comfortable to work with (1st, 3.903), operatives' engagement in improper conduct that could endanger their safety (2nd, 3.724), ineffective communication between health and Safety

Managers and workers (3rd, 3.476), insufficient instructions about the working condition and environment (4th, 3.348), lack of proper knowledge on the hazards management (5th, 3.214), workers inadequate or lack of understanding about the workplace safety rules (6th, 3.132) and inadequate engagement of Safety (7th, 3.101). Other factors tested were not equally important as their overall mean scores below 3 points out of 5 points in the Likert scale.

5. Conclusion

Top safety improvement measures to be adopted in construction sites includes routine check of scaffold, ladder, plant and equipment, conduct in-house safety training, use of safety audio, video and visual displaying gadgets on site, improved site layout planning, allocate budget for safety management, etc.Based on overall mean score of professional and site operative, some provisions such as first aid provision, following safety regulation/ legislations and discussion on health and safety matters are seen in construction site of Nepal. This study has shown that workers feel responsible for wearing PPE and believe that wearing PPE can help protect from work related injuries. They are often asking their supervisors for provision of appropriate and adequate PPE but the management has not maintained sufficient stock of appropriate safety wears. Major factors preventing effective use of safety wears include uncomfortable safety wears, workers engagement in improper conduct, ineffective communication between safety managers and workers, insufficient instructions about working condition and environment, lack of proper knowledge on hazards management and workers inadequate or lack of understanding about the workplace safety rules.

This study does not cover all types of construction industry of Nepal. It is limited only on the parameters defined and did not incorporate with the type and cost of particular type of safety wears for specific task. This study considered the safety of workers in workplaces but did not deal with the safety of third parties like authorized visitors, nearby community members, etc.

It should be statutory duty for employers and contractors to provide their employees with required PPE and maintain and replace them whenever necessary. Management must conduct effective safety training and maintain adequate PPE facilities on workplaces. Cost should be allocated separately in the Bill of Quantities (BOQ) for every aspect of occupational health and safety. Arrangement must be made to monitor health and safety performance by safety supervisors and periodic inspection from GoN/ Labour office.

Conflict of Interest

Not declared by the authors.

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References

1. Abdelhamd, T. S., & Everett J. G. (2000). Identifying root causes of construction accidents. Journal of construction engineering and management.
2. Asfahl, C. Ray. (1999). Industrial Safety and Health Management. (4th ed.). New Jersey: Prentice Hall,

Print.

3. Faroqui, Ahmed and Panthi. (n.d.). Addressing the Issue of Compliance with Personal Protective Equipment on Construction Worksites: A Workers' Perspective.

4. Guldenmund, F., Cleal, B., & Mearns, K. (2013). An exploratory study of migrant workers and safety in three European countries. Safety science.

5. ILO, (2007). International Labor Organization in the OSHA newsletter. Retrieved from: www.ttl.fi/en/publications/.../african_newsletter/pages/default.aspx

6. Irizarry, J., Simonsen, K. L., & Abraham, D. M. (2005). Effect of safety and environmental variables on task durations in steel erection. Journal of construction engineering and management.

7. Manandhar, R. (2016). A Thesis on Effect of Educational Intervention on Awareness about Occupational Safety and Health Among Workers in Building Construction Industry.

8. Mat Zin, S. & Ismail, F. (2011). Employers' Behavioral safety compliance factors towards occupational safety and health improvement in the construction industry.

9. Muema, L. M. (2016). Evaluation of personal protective equipment utilization among construction workers in Mombasa County, Kenya.

10. Muhammad B. A, Abdulateef I. & Ladi B. D. (2015). Assessment of Cost Impact in Health and Safety on Construction Projects. American Journal of Engineering Research (AJER).

11. Nepal GDP from construction. Retrieved from: https://tradingeconomics.com/nepal/gdp-from construction

12. Occupational Safety and Health Administration (2004). U.S. Department of Labor OSHA. Personal Protective Equipment 3151-12R.

13. Okolie, K. C., & Okoye, P. U. (2012). Assessment of national culture dimensions and construction health and safety climate in Nigeria. Science Journal of Environmental Engineering Research. 12:1-6. doi: 10.7237/sjeer/167

14. OSHA. (2007). Occupational Safety and Health. Laws of Kenya on occupational health and safety in a work place

15. Poudyal, S. (2018). A Thesis on A Study on Current Safety Practices in Tunnel Construction of Nepal.

16. Rudra Prasad Gautam and Giba Nath Prasain. (2011). Current Situation of Occupational Safety and Health in Nepal. General Federation of Nepalese Trade Unions (GEFONT).

17. Umeokafor, N., Isaac, D., Jones, K., & Umeadi, B. (2014). Enforcement of occupational safety and health regulations in Nigeria: An exploration. European Scientific Journal.

18. World Health Organization. (2002). Safety and health report in construction sites, New York. Washington D.C.