Utilization of personal protective equipment and associated factors among large-scale factory workers using health belief model in Debre-Berhan town, Amhara region, Ethiopia, 2021

Wondimu Sema

Debre Berhan University health science college

Muluken Tessema (✉ mklitmuluken@gmail.com)

DBU: Debre Berhan University   https://orcid.org/0000-0001-6222-3902

Abstract

Background

Personal protective equipment is designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Objective

To determine Personal Protective Equipment utilization and its associated factor based on health belief model among large scale factory workers in Debre-Birhan, Ethiopia.

Methods

An institution-based cross-sectional study was employed in Debre Berhan Town, North Shoa Ethiopia from April 1 st to May 1 st , 2021 using an interviewer administered structured questionnaires. A total of 412 samples were selected by systematic random sampling method. The data was entered by Epi-data version 3.1 and analyzed by SPSS. variables with a p-value of 0.2 was fitted for multiple logistic regressions and a p-value of <0.05 was statistically significant.

Result

A total of 412 workers were participated in the study with a 100% response rate. The mean age was 29 (±7.3) years. Most workers 367 (89 %) knew that PPE can prevent work related injury and illness. Over all 172 (41.7 %) of the workers were considered to have good PPE utilization. Perceived susceptibility [AOR=1.2, 95 %, CI (1.076-1.38)], perceived severity, [AOR=1.1, 95 %, CI (1.088-1.163)], perceived self-efficacy, [AOR=1.2, 95 %, CI (1.082-1.349)], and Perceived barrier [AOR=0.87, 95 %, CI (0.800 -0.956)] were found to be significant predictors of good PPE utilization.

Conclusion

The study revealed that good Personal protective equipment utilization in large scale factory workers. Perceived susceptibility perceived severity, perceived barrier and perceived self-efficacy were found to be predictors of PPE utilization.

Introduction

Personal protective equipment is designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. It may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits[1]. It is a significant determining factor between an accident and safety in the working environment. Evidence suggests that wearing the correct personal

protection at all times is extremely important in reducing accidents and should be given high priority[2]. Globally, 34% of occupational accidents were resulting from the lack of use of PPE available at workplace at the time of the accident. In addition, 13% of work-related accidents result from the inappropriate use of PPE[3].

While the use of personal protective equipment has been identified as an important hazard control strategy in work environments where it may not be practical to adopt other strategies, there is a great concern however that PPE usage remains low[4]. Evidences indicated that workers use of PPE is influenced by various factors. It has been reported that the influencing factors include Socio-demographic factors, perception about Occupational disease and Expectations of the benefits and Barriers of PPE use[5, 6].

In Ethiopia, reports indicated that only 5 to 10% of workers have access to occupational health services in their respective workplaces[7]. But nearly half [44.66%] of the workers in Ethiopia were experienced occupational injury. Upon reviewing several literatures about occupational health and safety among factory workers for this study, the PPE utilization rate typically ranges between 20.6% and 82.4% [7–10].

Methods

Study design, area and period

An institutional based cross-sectional quantitative study design was employed. from April 1st to May 1st, 2021 in Debre Birhan North Shoa, Amhara region Ethiopia. Based on CSA estimation the town has a total population of 114,652, of whom 51,843 are men and 62,809 women. It is located approximately 130 km northeast of the capital Addis Ababa and has a total of 22 large scale factories. These factories are mainly involved in the production of processed food, textile, beverage, glass and other products. The town is one of the preferred investment destinations in the country. This study was conducted at selected large scale factories found in Debre Birhan Town.

Source Population

All large scale factory workers in Debre Birhan town were considered as a source populations. Study Population

Factory workers working in the selected factories in Debre Birhan town who were meet the inclusion criteria.

Study Unit

Selected factory workers working in the selected factories in Debre Birhan town who were meet the inclusion criteria.

Inclusion Criteria

All factory workers that were present at work during the study period were considered for the study.

Exclusion criteria

Factory workers working in quality control and finishing section in beer and blanket factories respectively.

Sample size determination

The Sample size for the dependent variable was calculated using single population proportion formula based on the following assumptions. Utilization of PPE was taken from a study done at Kombolcha textile factory which was 58.2% [16], Level of confidence 95%, margin of error 5% non-response rate 10% and gives a sample size of 412. Similarly, for associated factors, by taking significantly associated variables with multivariate analysis in different studies, the sample size is calculated by using Epi Info 7 STATCAL software, cohort or cross sectional study.

Sampling technique and procedure

A total of 22 large scale factories in Debre-Birhan town were considered for sampling. Based on the assumption of 30% representativeness 7 factories were selected by simple random selection method. Before the data collection was started all the necessary PPE for the workers working in different sections of the factory was identified based on literatures[45, 46]. Workers utilizing the similar type of PPE were considered for this study. The required sample size was taken proportional to the size of the selected factories. To get the individual sample at the selected factory systematic random sampling was conducted by using the total number of factory workers who have worked during the study period and number of sample required in each selected factory. After getting the sampling fraction in the selected factory the first participant was obtained by lottery method among the first "k" units.

Data Collection Method

Interviewer administered structured questionnaire was used to collect the required quantitative information on utilization and determinates of PPE use. Questionnaire is developed after review of similar literatures [16, 17, 28]. It includes: socio-demographic characteristics of the workers, knowledge about PPE & occupational exposures and seven HBM construct measures, namely: perceived susceptibility of occupational-related health problems, Perceived severity of occupational-related health problems, perceived benefits of using PPE, perceived barriers to using PPE, perceived self-efficacy of using PPE, and cues to action of using PPE. The constructs of HBM was answered on a 5-point Likert's scale [1 = strongly disagree; 5 = strongly agree]. The score of each participant was summed to get a score for each construct.

The questionnaire is prepared in English and translated to Amharic. The required data was collected by Four Environmental health professionals. Training was provided for data collectors on different issues regarding the research.

Data Processing and Analysis

The collected data was checked for its completeness manually; data entry was done using Epi-data version 3.1. The entered data was exported to SPSS version 21 for further cleaning and analysis. Data editing, coding, checking and organization was done to transform the data into format suitable for further analysis. The model fitness was checked by Hosmer Lomeshow goodness of fit test. Assumptions of model including Multicollinearity and outlier were checked by variance inflation factor [VIF] and normal P-P plot respectively. All independent variables were fitted separately into binary logistic regression model to evaluate the degree of association with utilization of PPE. The variables with a p-value < 0.20 was fitted to multiple logistic regression model. Then, AOR value with 95% CI was calculated to identify independent variables which were significantly associated with PPE utilization, a p-value < 0.05 was used as level of significance for the final qualifiers as factors associated with PPE utilization.

Results

Socio-demographic characteristics of factory workers

A total 412 factory workers were involved in this study with 100% response rate. As shown in table 1 below the participants were predominantly male [66.3%]. The age of the participants were ranged from 18 to 57 with the mean age of 29.4[±7.3] years. Majority of [97.3%] the participants were employed on a permanent basis with a small percentage of temporary workers 11 [2.7%]. Concerning marital status of the workers 47.3% were married [Table-1].

Table 1. Socio-demographic characteristics of large scale factory workers in Debre-Birhan, town Ethiopia. June, 2021

Variable	Categories	Frequency	Percent
Sex	Male	273	66.3%
	Female	139	33.7%
Age	18-28	220	53.4
	29-39	140	34.0
	>39	52	12.6
Educational level	Primary	10	2.4
	Secondary	69	16.7
	Diploma	203	49.3
	First degree and above	130	31.6
Marital status	Married	195	47.3
	Single	213	51.7
	Others [a]	4	0.9
Employment form	Temporary/ contract/	11	2.7
	Permanent	401	97.3
Working experience	< 5	321	77.9
	5-10	60	14.6
	>10	31	7.5
Income	500-2500	151	36.7
	2501-4500	118	28.6
	4501-6500	127	30.8
	>6501	16	3.9

NB- a- [widowed and divorced]

PPE Utilization Status

Overall, 41.7 % [95% CI, 37.1-46.1] of the factory workers had good PPE utilization. The utilization was highly varied among the type of PPE. Respirator was found to be the most utilized PPE with a mean utilization score of 3.94±1.42 followed by coverall. On the other hand ear protector [1.14±1.0.6] was found to be the least utilized PPE. Helmet, Eye protector, coverall, safety shoe, glove had a mean utilization score of 2.11 ±1.26, 2.53±1.6, 3.42±1.7; 2.95±1.82 and 2.41±1.64 respectively [Table 2].

Table 2 PPE utilization frequency score of large scale factory workers in Debre-Birhan Town, Ethiopia. June, 2021.

Type of PPE	Frequency [%]					Mean	SD
	Never	Rarely	Sometimes	Often	Always		
Helmet	178[43.2]	105[25.5]	69[16.7]	25[6.1]	35[8.5]	2.11	1.26
Eye protector	160[38.8]	103[25]	30[7.3]	10[2.4]	109[26.5]	2.53	1.63
Ear protectors	385[93.4]	14[3.4]	2[0.5]	4[1]	7[1.7]	1.14	0.62
Respirator	53[12.9]	22[5.3]	46[11.2]	67[16.3]	224[54.4]	3.94	1.42
Coverall	85[20.6]	86[20.9]	21[5.1]	10[2.4]	210[51]	3.42	1.71
Safety shoe	168[40.8]	32[7.8]	27[6.6]	24[5.8]	161[39.1]	2.95	1,82
Glove	215[52.2]	17[4.1]	60[14.6]	35[8.5]	85[20.6]	2.41	1.64

Knowledge towards PPE utilization

In this study 367 [89 %] of workers knew that PPE can prevent work related injury and illness, of them 164 [39.8 %] were good PPE utilization. Generally in this research 342[83%] of factory workers had good knowledge about PPE, while the remaining 70[17%] of workers had poor knowledge regarding PPE utilization.

Perception towards occupational disease and PPE utilization

 Concerning perception of workers towards PPE utilization and occupational disease, it was measured using HBM constructs and treated as a continuous variable as shown in table 4 and 5 below. The mean score of Perceived Susceptibility was found to be 17.1[±8.7]. For Perceived severity possible values ranging from 7 to 35 and the mean score was 20.2[±11.4]. In addition the mean scores of Perceived benefit, Perceived   barrier, Cues to action, Perceived self- efficacy was found to be 10.5[±5.8], 22.0[±9.3], 29.2[±8.9], 15.7[±7.6] respectively.

Table 3. Health belief model construct response of factory worker in Debre-Birhan Town, Ethiopia, June, 2021.

HBM Constructs	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Perceived Susceptibility	F [%]	F [%]	F [%]	F [%]	F [%]
It is extremely likely I will get occupational illness or injury in the future.	122[29.6]	87[21.1]	51[12.4]	40[9.1]	112[27.2]
I think my chance of developing occupational illness is grate	83[20.1]	122[29.6]	60[14.6]	35[8.5]	112[27.2]
There is a good possibility I will get occupational illness in the next few years.	77[18.7]	98[23.8]	40[9.7]	115[27.9]	82[19.9]
I know predecessors in this career field who got an occupational illness	115[27.9]	92[22.3]	47[11.4]	23[5.6]	135[32.8]
I think small exposures to occupational chemicals or noise will lead me to an illness.	139[33.8]	81[19.7]	4[1.0]	84[20.4]	104[25.2]
I am more likely than the average worker to have occupational illness or injury	152[36.9]	115[27.9]	16[3.9]	21[5.1]	108[26.2]
Perceived severity					
The thought of getting an occupational illness is deeply concerns me	163[39.6]	92[22.3]	16[3.9]	15[3.6]	126[30.6]
If I developed an occupational illness, my career would be in danger	157[38.1]	50[12.1]	13[3.2]	16[3.9]	176[42.7]
Problems I would experience from an occupational illness would last a life time	73[17.7]	139[33.7]	9[2.2]	49[11.9]	142[34.5]
An occupational illness will lead to permanent changes in my health	204[49.5]	54[13.1]	5[1.2]	19[4.6]	130[31.6]
My financial security would be endangered if I developed an occupational illness	146[35.4]	56[13.6]	19[4.6]	13[3.2]	178[43.2]
I believe I could die prematurely if I developed an occupational illness	131[31.8]	89[21.6]	7[1.7]	33[8.0]	152[36.9]
I am afraid to even think about getting an occupational illness	85[20.6]	131[31.8]	29[7.0]	2[0.5]	165[40]

Perceived benefits

Wearing PPE will prevent me from occupational illness	188[45.6]	61[14.8]	16[3.9]	66[16]	81[19.7]
PPE prevents exposure to the kinds of hazards you are around on the job	112[27.2]	116[28.2]	43[10.4]	60[14.6]	81[19.7]
I worry about getting an occupational illness when I don't wearing PPE	144[35]	120[29.1]	15[3.6]	33[8.0]	100[24.3]
I benefit by wearing PPE	118[28.6]	131[31.8]	12[2.9]	30[7.3]	121[29.4]

Perceived barriers

When I wear PPE I feel uncomfortable	136[33.0]	21[5.1]	11[2.7]	142[34.5]	102[24.8]
When I wear PPE, it interferes with my ability to do my job	124[30.1]	74[18.0]	12[2.9]	107[26.0]	95[23.1]
PPE is not always available to me	115[27.9]	66[16.0]	11[2.7]	138[33.5]	82[19.9]
When I wear PPE co workers would make fun of me	85[20.6]	107[26.0]	7[1.7]	74[18.0]	139[33.7]
My supervisor is aware of my compliance with PPE guidelines	66[16.0]	70[17.0]	14[3.4]	118[28.6]	144[35.0]
I would need to develop a new habit for wearing PPE, and that is difficult to me	80[19.4]	113[27.4]	16[3.9]	80[19.4]	123[29.9]
Wearing PPE is just too inconvenient for you	48[11.7]	158[38.3]	12[2.9]	58[14.1]	136[33.0]

Cues to action

A reminder from my supervisor everyday would be important to wear of PPE	135[32.8]	30[7.3]	97[23.5]	54[13.1]	96[23.3]
My supervisor checking on me would improve you to wear of PPE	33[8.0]	109[26.5]	73[17.7]	89[21.6]	108[26.2]
My employer is important for wearing PPE	25[6.1]	93[22.6]	90[21.8]	95[23.1]	109[26.5]
Posters in my factory would serve as important reminders to wear PPE	46[11.2]	92[22.3]	46[11.2]	105[25.5]	123[29.9]
The threat of disciplinary action is an important factor in ensuring I wear PPE	66[16.0]	72[17.5]	86[20.9]	96[23.3]	92[22.3]
Having PPE at location of hazard is critical to ensure that I wear it	72[17.5]	62[15.0]	54[13.1]	123[29.9]	101[24.5]
If you see others wearing PPE in your area, then it reminds you to use it	110[26.7]	24[5.8]	62[15.0]	65[15.8]	151[36.7]
Regular and frequent education on the importance of PPE improves how often I wear it	86[20.9]	70[17.0]	38[9.2]	46[11.2]	172[41.7]
My supervisor sets the example on wearing PPE when being exposed to hazard	77[18.7]	113[27.4]	40[9.7]	32[7.8]	150[36.4]

Self-efficacy

I am confident that I remember to use PPE when I am exposed to hazards at	108[26.2]	89[21.6]	11[2.7]	38[9.2]	166[40.3]

work					
I am confident I can obtain the proper PPE when I am exposed to hazards at work	101[24.5]	83[20.1]	40[9.7]	25[6.1]	163[39.6]
I am confident that my job performance will NOT be impacted by wearing PPE	104[25.2]	76[18.4]	36[8.7]	19[4.6]	177[43.0]
I am confident that the PPE I use when I am exposed to hazard is the proper equipment to protect my health	25[6.1]	163[39.6]	19[4.6]	24[5.8]	181[43.9]
I am confident that after wearing the proper PPE throughout my career will prevent me from getting an occupational illness	156[37.9]	17[4.1]	7[1.7]	70[17.0]	162[39.3]

Table 4 Health belief model construct score of large-scale factory worker in Debre-Birhan Town, Ethiopia. June, 2021

	Perceived susceptibility	Perceived severity	Perceived benefit	Perceived barrier	Cues to action	Perceived self- efficacy
mean	17.1	20.2	10.5	22.0	29.2	15.7
Min	6.00	7.00	4.00	7.00	9.00	5.00
Max	30.00	35.00	20.00	35.00	45.00	25.00
SD	8.7	11.4	5.8	9.3	8.9	7.6

Multivariate analysis of associated factors

Of the total eight potential candidate predictors of PPE utilization of factory workers that were included in the multiple logistic regression model, only four of them [Perceived susceptibility, perceived severity, Self-efficacy and perceived barriers] were found as predictors of PPE utilization [Table 5].

Generally, after controlling possible confounding factors the result of the research indicated that per a unit increases in the total score of perceived susceptibility towards PPE utilization the odds of using PPE was increased by 20% [AOR=1.2, 95 %, CI [1.07-1.38]]. Similarly per a unit increases in the total score of perceived severity towards PPE utilization the odds of using PPE was increased by 10%, [AOR=1.1, 95 %, CI [1.01-1.16]]. The other variable which independently associated with PPE utilization was Perceived Self-efficacy in which, per a unit increases in the total score of perceived self-efficacy towards PPE utilization the odds of using PPE was increased by 20%, [AOR=1.2, 95 %, CI [1.08-1.34]]. Perceived barrier

was also found to be a negative predictors of PPE utilization in which per a unit increases in the total score of Perceived barrier towards PPE utilization the odds of using PPE was decreased by 13%, [AOR=0.87, 95 %, CI [0.80 -0.95]].

Table 5. Multivariate analysis of factors associated with PPE Utilization among factory workers in Debre-Birhan town, Ethiopia, June 2021.

Variable	Categories	COR	95% CI		p-value	AOR	95% CI		p-value
			L	U			L	U	
Sex	Male	1.43	.944	2.19	0.09	.77	.26	2.28	.645
	Female	1.00				1.0			
Income	500-2500	.540	.179	1.63	.274	.05	.00	56.55	.421
	2501-4500	.233	.076	.717	.011	.06	.00	69.48	.455
	4501-6500	.201	.066	.619	.005	.06	.00	73.64	.454
	>6501	1.00				1.00			
Knowledge	Good	2.58	1.43	4.64	.002	1.9	.51	7.34	.332
	Poor	1.00				1.00			
Perceived susceptibility		1.465	1.364	1.573	<0.001	1.2	1.07	1.38	.002*
Perceived severity		1.311	1.248	1.377	<0.001	1.1	1.01	1.16	.012*
Perceived benefit		1.059	1.024	1.095	0.001	1.05	.95	1.17	.302
Perceived barrier		.713	.670	.758	<0.001	.87	.80	.95	.003*
Self-efficacy		1.422	1.338	1.510	<0.001	1.2	1.08	1.34	.001*

*-significant at p<0.05

Discussion

The finding of this research indicated that, only 172 [41.7 %] of the workers were considered to have good PPE utilization. This finding was much lower than the study done in Thailand and Addis Ababa, which indicated that [70.1%] and [64.80%] of the workers had good PPE utilization respectively [22, 30]. On the contrary the finding of this research was higher than the study done in Gujarat, India that showed only 25 % of the workers were considered to have good PPE utilization[50]. This difference might be due to

methodological differences, like study population and methods of data collection, and workplace conditions, employees' level of awareness on hazard control and disease prevention.

The use of PPE varied considerably depending on the item examined with the respirator and coverall being the most commonly used protective items. The finding was inconsistent with the study done in Hawasa town among Wood and Metal Worker that showed eye protector and safety shoe were the most utilized protective items[51]. On the other hand, in this research ear protector was found to be the least utilized type of PPE. The finding was different with the study done in Missouri, USA that indicates helmet was found to be the least utilized PPE type[52]. This difference might be due to the difference in the nature of factories considered in the study.

In this research none of the socio-demographic factors were significant at a p value of < 0.05. This finding was inconsistence with the study done in different countries. For example a research done in Uganda showed that among the socio-demographic factors sex was found to be a significant predictors of PPE utilization in which Female respondents were used PPE more than male respondent [AOR] = 6.64; 95% CI: 1.55–28.46[24]]. Similarly in Nepal Female respondents were used PPE 3.65 times than male [AOR] = 6.64; p = 0.031][53]. This difference might be due to the difference in educational level and culture of the participants.

Another socio-demographic factor which was found to be insignificant predictors of PPE utilization was age of the workers. The finding was consistent with the study done in Uganda and Mombasa County, Kenya[24, 27]. But finding of this research regarding age was against with different research. For instance a research conducted in Indonesia among a sample of 200 workers indicated that, workers who have the age of greater than 30 years have the possibility to use PPE 7.54 units higher than those below 30 years[54].

Similarly employment form, income, working experience and marital status was among the socio-demographic factors that were not predictors of PPE utilization. Similar finding was obtained from a study conducted in Kenya and Addis Ababa, in which employment form, income, working experience and marital status were not determinate factors of PPE utilization[27, 41].

Regarding the HBM constructs, Perceived susceptibility, perceived severity, Perceived self-efficacy and perceived barriers were significantly associated with PPE utilization. On the other hand perceived benefit and cues to action towards PPE utilization were not found to be independent predictors.

Perceived susceptibility of occupational illness and injury has shown statistically significant association with PPE utilization. The study showed that as a unit increase in total score of perceived susceptibility the odds of utilizing PPE was also increased by 20%. This finding is in line with different studies conducted in USA and Thailand [28, 30]. This might be explained as the study participants those having high susceptibility may belief that using PPE has the potential to protect work related disease and injuries. Similarly as a unit increases in total score of perceived severity the odds of using PPE was increased by 10%. This finding is consistent with the studies conducted in Indonesia and USA. This might be due to the

workers beliefs about the seriousness of the occupational illness, injury and possible outcome of the disease. The other explanation may be high perceived susceptibility and severity towards occupational illness and injury may also increase the perceived threat of respondents; thus the participants could use PPE. In general, workers who perceived as they are highly susceptible to work related illness & injury and that they perceived work related disease is a serious disease, they would be more likely to utilized PPE.

The other predictor variable towards PPE utilization was perceived barrier, it was significantly associated with PPE utilization and it indicated that as a unit increases in sum score of perceived barriers the odds of using PPE was decreased by 13%. Similar finding was reported from cross-sectional study conducted in Hawassa and Nigeria that showed barriers like inconvenience, unavailability, and increased cost were found to be predictors of PPE utilization[55, 56].

Self-confidence in using PPE [perceived self-efficacy] was found to be a significant predictor of PPE utilization, in which, per a unit increases in the total score of perceived self-efficacy towards PPE utilization the odds of using PPE was increased by 20%, [AOR = 1.2, 95 %, CI [1.082–1.349]]. The possible justification might be People with high self-efficacy show elevated confidence in their skills and have no doubt about themselves. In these cases, factory workers consider the problems as a challenge, not a threat, and they actively search for new situations. In addition, high self-efficacy reduces fear of failure, increases the level of motivation, and improves problem-solving and analytical thinking abilities. In the same way, high self-efficacy in working a hazardous environment may promote the use of PPE.

On the other hand, Perceived benefit [AOR = 1.05, 95 %, CI [0.95–1.17, P = .302]] were not found to be predictors of PPE utilization. This finding was in line with the study done in USA, in which Perceived benefit towards using PPE was not found to be independent predictors. Similarly cues to action were not predictors of PPE utilization. The finding is inconsistent with the study done in Indonesia to identify factors influencing the use of PPE [[OR = 7.17; 95%CI = 2.17 to 23.62; p = 0.001]. This inconsistency may be due to the difference of educational level, media exposure and culture of the participants.

Conclusion

The finding revealed that good PPE utilization among large-scale workers. Perceived susceptibility, Perceived severity, perceived self-efficacy and Perceived barrier were found to be strong predictors of PPE utilization.

Limitation Of The Study

Since the study is cross sectional it does not show cause and effect relationship between dependent and independent variables.

Recommendations

- For Health professionals delivering health education or health information to increase personal protective equipment utilization should provide special emphasis to susceptibility and severity of occupational disease and injuries.
- For Regulatory bodies, workers association and other stake holders working to increase personal protective equipment utilization should focus on modification of barriers and increasing self-confidence of workers in using PPE.
- For factory managers in order to increase personal protective equipment utilization focus on reducing barriers of   PPE utilization.

Abbreviations

PPE: Personal protective equipment, HBM: Health belief model, OSHA: Occupational Health and Safety Act.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institution Review Board of Debre Berhan University with a protocol number of 28/21/CHS/SPH. All participants of the study provided with informed verbal consent, clearly stating the objectives of the study and the right of study participants. All participants were randomly selected without any discrimination and filled out questionnaires were carefully handled and all access to results kept strictly.

Availability of data and materials

The data collected for this study can be obtained from the first or last author upon a reasonable request.

Funding

Acknowledgements

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable

Authors' contributions

Authors involved in designing, proposal writing, data collection, analyzing the data, drafted the first version of manuscript, and participated in all phases of the project. All authors read and approved the final version of the manuscript before submission.

References

1. Safety O, Administration H. Personal protective equipment. US Department of Labor Regulations: OSHA; 2016.

2. Ahmed SM, et al., *Addressing the issue of compliance with personal protective equipment on construction worksites: A workers' perspective*. 2015.

3. Jafaralilou H, et al. The impact of theory-based educational intervention on improving helmet use behavior among workers of cement factory, Iran. J Egypt Public Health Assoc. 2019;**94**[1]:1–7.

4. Munyua FW. Factors influencing use of personal protective equipment [PPE's] by motor vehicle repair workers in Kigandaini, Thika. University of Nairobi; 2017.

5. Baksh K, Ganpat W, Narine L. *Farmers knowledge, attitudes and perceptions of occupational health and safety hazards in Trinidad, West Indies and implications for the Agriculture sector*. Journal of Agricultural Extension and Rural Development, 2015. **7**[7]: p. 221–228.

6. Bakhsh K, et al. Health hazards and adoption of personal protective equipment during cotton harvesting in Pakistan. Sci Total Environ. 2017;598:1058–64.

7. Alamneh YM, et al. The prevalence of occupational injury and its associated factors in Ethiopia: a systematic review and meta-analysis. Journal of Occupational Medicine Toxicology. 2020;**15**[1]:1–11.

8. Tadesse S, Kelaye T, Assefa Y. *Utilization of personal protective equipment and associated factors among textile factory workers at Hawassa Town, Southern Ethiopia*. Journal of Occupational Medicine and Toxicology, 2016. **11**[1]: p. 6.

9. Demeke A. Assessment of the utilization of personal protective equipment among textile industry Workers in Dukem Town. Addis Ababa University; 2017.

10. Gebremichael G, Kumie A. *The prevalence and associated factors of occupational injury among workers in Arba Minch textile factory, southern Ethiopia: a cross sectional study*. Occupational medicine and health affairs, 2015. **3**[6]: p. e1000222-e1000222.

11. JUKKA TAKALA, et al., *Burden of Injury and Illness at Work in Selected Contries and Regions*. Central European Journal of Occupational and Environmental Medicine, 2017. **23** [7]: p. 1–2.

12. Hämäläinen P, Takala J, Kiat TB. Global estimates of occupational accidents and work-related illnesses 2017. World. 2017;2017:3–4.

13. Pratik K, Jasani*, et al., *A study of knowledge and utilization of safety measures against occupational hazards among workers in Surendranagar city, Gujarat, India*. International Journal of

Community Medicine and Public Health 2016.

14. Labor TMo. National policy on Occupational Health and Safety. Namibia: Windhoek; 2016.

15. Chepkener AC. Knowledge, Attitude And Practice Of Eye Safety Among Jua Kali Industry Workers In Nairobi, Kenya. University of Nairobi; 2013.

16. Zegeorgous KG, et al., *Utilization of personal protective equipment and associated factors among Kombolcha Textile Factory workers, Kombolcha, Ethiopia: A cross-sectional study*. J Public Health, 2020. **7**[100025P16KZ2020]: p. 100025P16KZ2020.

17. Wall J, *Development of a health-belief-modelbased instrument to assess worker beliefs about using personal protective equipment. The University of Utah*. 2009, Master Thesis. Utah.

18. O., O.K., E.J. E., and Hosea O. *Utilization of Personal Protective Equipments [PPEs] among Wood Factory Workers in Calabar Municipality, Southern Nigeria* 2017: p. 1.

19. ILO. The Prevention of Occupational Diseases: World Day for safety and health at work 28 April 2013. Switzerland: International labour Office Geneva; 2013.

20. RrDianTristiana RatihPravitasari, ErnaDwiWahyuni. *Contributing Factors of Personal Protection Equipment [PPE] Utilization among Sandand Gravel [SSG] Mine Workers*. International Journal o fPsychosocial Rehabilitation 2020. **24**[7].

21. *Labour Proclamation.* in *89*. FEDERAL NEGARIT GAZETTE OF THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA: Addis Ababa. p. 11691.

22. Duguma* FK, et al., *Assessment of Safety Equipment Utilization Rate and Magnitude of Occupational Related Incidences Among Workers in the Ministry of Defense Construction CMC Site, Addis Ababa, Ethiopia*. Civil Eng Res J 2018. **9**[2].

23. SR A. *Utilization Pattern of Personal Protective Equipment among Industrial Workers of Nawalparasi, Nepal*. Journal of Public Healt, 2014. **13** [[Issue II].

24. Izudi J, Ninsiima V, Alege JB, *Use of personal protective equipment among building construction workers in Kampala, Uganda.* Journal of environmental and public health, 2017. **2017**.

25. Dewi RD, Rahardjo SS, Murti B. *Application of Health Belief Model on Factors Influencing the Use Of Personal Protective Equipment*. in *6th International Conference on Public Health* 2019. Sebelas Maret University.

26. KYALO AM. LEVEL OF UTILIZATION OF PERSONAL PROTECTIVE EQUIPMENT AMONG WORKERS IN GRAIN AND OIL SEED MILLING INDUSTRIES IN NAIROBI CITY COUNTY, KENYA. KENYATTA UNIVERSITY; 2016.

27. Muema LM. Evaluation of Personal Protective Equipment Utilization among Construction Workers in Mombasa County, Kenya. JKUAT: COHES; 2017.

28. Wright T, et al., *Issue of compliance with use of personal protective equipment among wastewater workers across the southeast region of the United States.* International journal of environmental research and public health, 2019. **16**[11]: p. 2009.

29. Damalas CA, Abdollahzadeh G. Farmers' use of personal protective equipment during handling of plant protection products: Determinants of implementation. Science of The Total Environment. 2016;571:730–6.

30. Panakobkit W, Sakunkoo P, CHamroen P. Health Belief Model and Behavioural Usage of Respiratory Protective Equipment among Sugarcane Workers in Northeast of Thailand: A Cross-sectional Analytical Study. Journal of Clinical & Diagnostic Research; 2019. **13**[12].

31. Kralam K, Taneepanichskul N, *Knowledge, Attitude and Practice towards Personal Protective Equipment Use among Steel Industry Workers in Thailand.* Journal of Health Research, 2016. **30**[Suppl. 2]: p. S161-S165.

32. Dita M, et al., *The Correlation Between Knowledge About Occupational Accidents and Safe Work Behaviors Among Employees at the Production Division of PT X Indonesia.* KnE Life Sciences, 2019: p. 123-131-123–131.

33. Umoren QM, et al., *An assessment of the effect of health education on the use of personal protective equipment among small scale welders [panel beaters] in Akwa Ibom state, Nigeria.* International Journal of Community Medicine and Public Health, 2016. **3**[11]: p. 3220–3228.

34. Johnson OE, Motilewa OO. *Knowledge and use of personal protective equipment among auto technicians in Uyo, Nigeria.* Journal of Education, Society and Behavioural Science, 2016: p. 1–8.

35. Beyene Gebrezgiabher B, Tetemke D, Yetum T, *Awareness of occupational hazards and utilization of safety measures among welders in Aksum and Adwa towns, Tigray region, Ethiopia, 2013.* Journal of environmental and public health, 2019. **2019**.

36. Orji R, Vassileva J, Mandryk R. *Towards an effective health interventions design: an extension of the health belief model.* Online journal of public health informatics, 2012. **4**[3].

37. Dewantara BP, Murti B, Widyaningsih V. *Application of Health Belief Model and Social Cognitive Theory on the Use of Personal Protective Equipment among Workers at the Plywood Plant: Path Analysis Evidence from Lumajang, East Java.* Journal of Health Promotion and Behavior, 2019. **4**[4]: p. 306–318.

38. Sari NK, Rahardjo SS, Widyaningsih V. *Factors associated with personal hygiene, use of personal protective equipment, and the risk of contact dermatitis among scavengers: A path analysis evidence from Surakarta, Central Java.* Journal of Health Promotion and Behavior, 2019. **4**[3]: p. 198–211.

39. Sharifzadeh MS, Damalas CA, Abdollahzadeh G. RETRACTED: Perceived usefulness of personal protective equipment in pesticide use predicts farmers' willingness to use it. Elsevier; 2017.

40. Okello T, et al., *Barriers and factors affecting personal protective equipment usage in St. Mary's Hospital Lacor in Northern Uganda.* East and Central African Journal of Surgery, 2017. **22**[1]: p. 59–65.

41. Alemu AA, et al. Utilization of personal protective equipment and associated factors among building construction workers in Addis Ababa, Ethiopia, 2019. BMC Public Health. 2020;20:1–7.

42. Hou S-I. *Health education: theoretical concepts, effective strategies and core competencies.* Health promotion practice, 2014. **15**[5]: p. 619–621.

43. DeJoy DM. Theoretical models of health behavior and workplace self-protective behavior. J Saf Res. 1996;**27**[2]:61–72.

44. Nisbet EK, Gick ML. *Can health psychology help the planet? Applying theory and models of health behaviour to environmental actions*. Canadian Psychology/Psychologie canadienne, 2008. **49**[4]: p. 296.

45. Ridley JR, Channing J. Workplace safety. Butterworth-Heinemann; 1999.

46. Bello SR. *WORKPLACE HAZARDS* 2012, North Charleston, SC 29418 US: Dominion Publishing Services.

47. ILO. Safety and health Tthe heart of future work: Building on 100 years of experience. Labour Inspection: Geneva 22 Switzerland: Labour Administration; 2019.

48. Meusburger P, Werlen B, Suarsana L. Knowledge and action. Springer Nature; 2017.

49. Health UDo, Services H. Theory at a glance: a guide for health promotion practice. Lulu. com; 2005.

50. Jasani PK, et al. A study of knowledge and utilization of safety measures against occupational hazards among constructional workers in Surendranagar city, Gujarat, India. Int J Commun Med Public Health. 2016;3:3055–8.

51. Esaiyas A, Sanbata H, Mekonnen Y. Occupational Health and Safety Related Knowledge, Attitude and Practice among Wood and Metal Workers in Hawassa, Ethiopia. Annual Research & Review in Biology; 2018. pp. 1–9.

52. Ramos AK, Fuentes A, Trinidad N. *Perception of job-related risk, training, and use of personal protective equipment [PPE] among Latino immigrant hog CAFO workers in Missouri: A pilot study*. Safety, 2016. **2**[4]: p. 25.

53. Acharya SR, *Utilization pattern of personal protective equipment among industrial workers of Nawalparasi, Nepal.* Health Prospect: Journal of Public Health, 2014. **13**[2]: p. 24–27.

54. Dewi RD, Rahardjo SS, Murti B. *Application of Health Belief Model on Factors Influencing the Use Of Personal Protective Equipment.".* in *6th International Conference on Public Health* 2019, *Surakarta, Indonesia, October 2019*. 2019.

55. Osonwa Kalu O, Jimmy EE, Ozah H. *Utilization of personal protective equipments [PPEs] among wood factory workers in Calabar Municipality, Southern Nigeria*. Age, 2015. **15**[19]: p. 14.

56. Tadesse S, Kelaye T, Assefa Y. Utilization of personal protective equipment and associated factors among textile factory workers at Hawassa Town, Southern Ethiopia. Journal of Occupational Medicine Toxicology. 2016;**11**[1]:1–6.
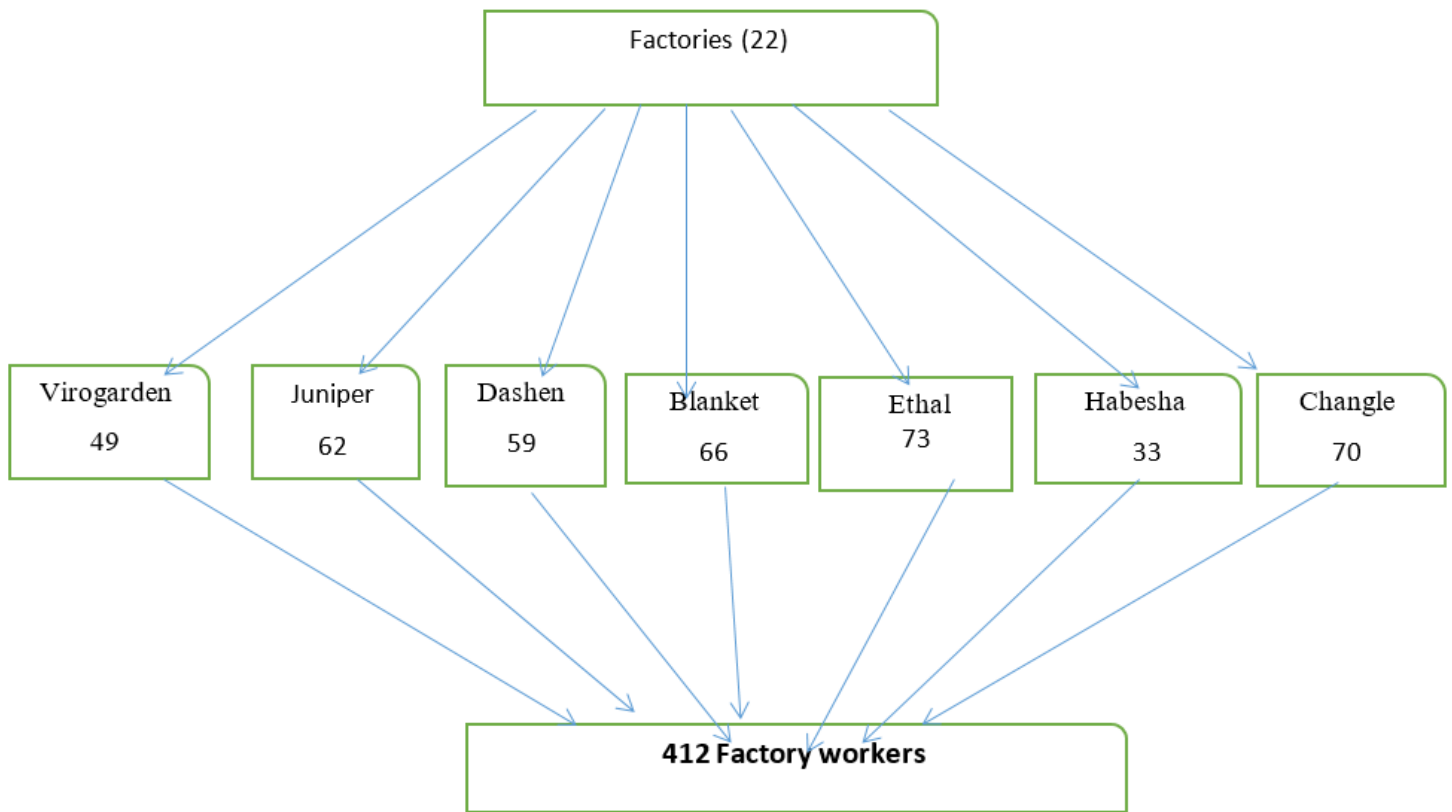
Figures

Figure 1

Schematic presentation of sampling procedure for PPE utilization and associated factors among large scale factory workers in Debre-Birhan town, 2021.
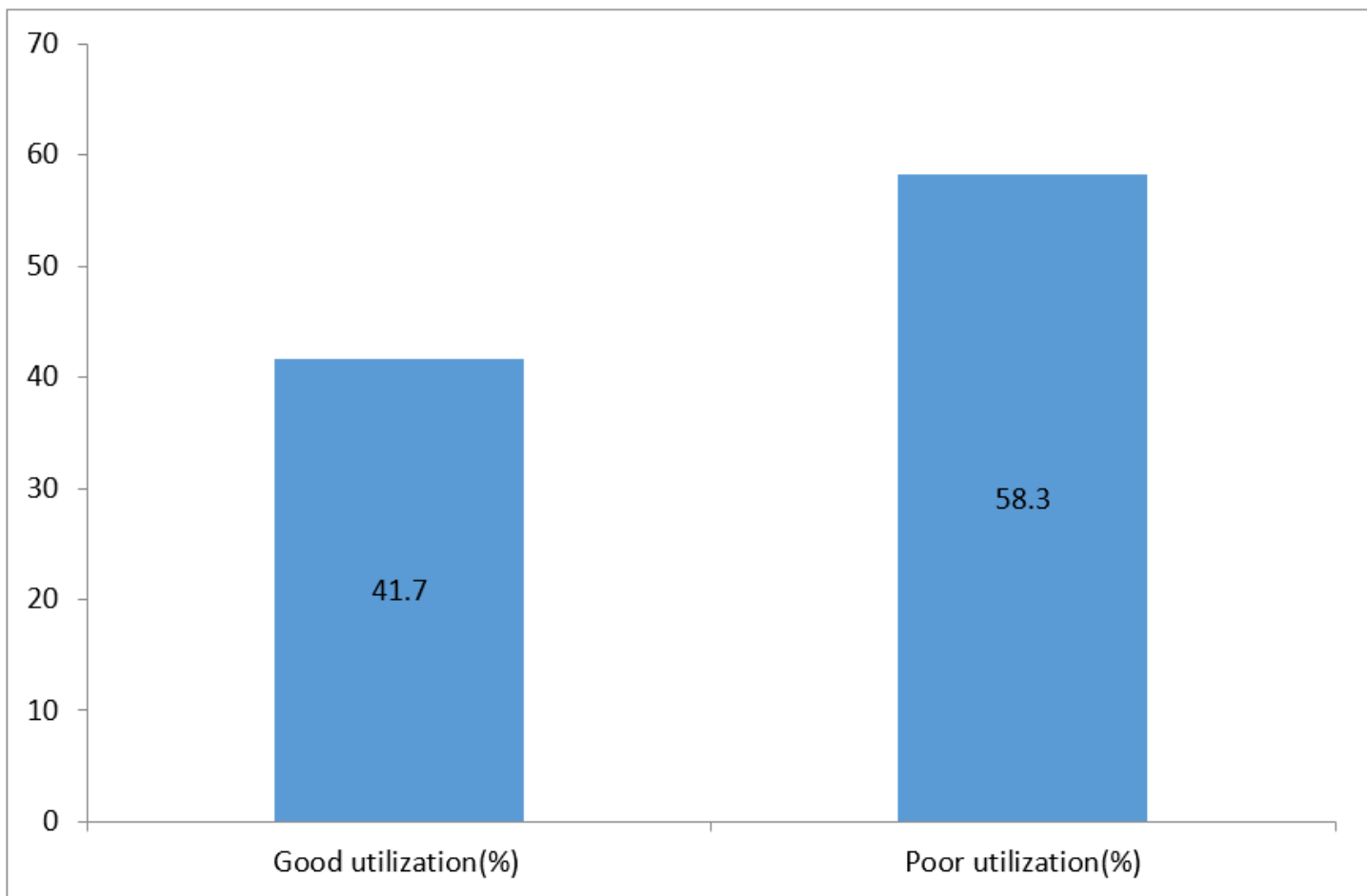
Figure 2

PPE utilization of large scale factory worker in Debre-Birhan Town, Ethiopia. June, 2021.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SF1.EnglishversionQuestionnaire.docx
- SF2.AmharicversionofQuestionnaire.docx