OCCUPATIONAL NOISE INDUCED HEARING LOSS AMONG CABLE INDUSTRY WORKERS AT 10TH OF RAMADAN CITY IN EGYPT

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Abstract:
Occupational Noise Induced Hearing Loss (ONIHL) is a major occupational health issue that burden both individual & society. Cable industry is a risky occupation where noise of the most common exposures affecting its working community. Objectives of current study: to assess the prevalence of ONIHL among cable workers and to detect occupational risk factors that had significant impact in development of NIHL. A cross sectional study was conducted among 170 workers working at cable industry at 10th Of Ramadan city in Egypt during the period from July 2022 to June 2023, using a semi structured questionnaire assessing present history of Auditory symptoms and applying Audiometry. The current study showed that (38.2%) of cable workers were diagnosed as occupational hearing loss, and reported auditory symptoms as (18.2%) suffered tinnitus, (9.4%) vertigo, (15.9 %) ear pressure at end of work shift and (7.1 %) difficulty in understanding speech in conversation. Results of present study indicated by regression analysis that current occupation was the most significant predictor of development of ONIHL. Implementation of engineering control measures, ensuring availability of properly designed personal protective equipment (PPE) with applying health education programs for workers about occupational health hazards they face and preventive measures are recommended.

Keywords: Occupational-Noise induced-Hearing loss-Cable workers-10th Of Ramadan-Egypt.

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INTRODUCTION

Noise production has raised parallel with the industrial growth and technologic advancements **(Azizi,2010).** Occupational noise-induced hearing loss (NIHL) has long been identified as a major occupational health issue. Rapid industrialization, especially in Asian countries, has caused a surge in the population of workers exposed to hazardous levels of noise at the workplace **(Ammar et al,2022).**

Worldwide, 16% of the disabling hearing loss in adults is attributed to occupational noise, ranging from 7 to 21% in the various subregions. The estimated cost of noise to developed countries ranges from 0.2 to 2% of the gross domestic product (GDP) **(Nandi & Dhatrak,2008).** Chronic exposure to noise levels exceeding 85 dBA is a known risk factor for developing NIHL. Acute NIHL can also occur during occupational exposure to loud impulsive noise **(Ammar et al,2022).**

The first signs of NIHL can be observed in the typical 4000-Hz ‘‘notch’’ observed on audiograms, indicating a loss of hearing ability in the middle of the frequency range of human voices. The notch grows deeper and wider with continued noise exposure, causing increasing impacts on speech communications (leading to social isolation and difficulties at home, work, and school),and disrupting the lives of those directly impacted, as well as their families, friends, and co-workers **(Nelson et al,2005).**

The impact of NIHL is not only limited to hearing disability, but it can also lead to loss of productivity, mental health issues, as well as an increased risk of injuries **(Ammar et al,2022).**

In addition to auditory outcomes, ONIHL has also been associated with a number of nonauditory sequelae. Bad mood, poor cognition, sleep disorders, and cardiovascular diseases are the frequent complications of ONIHL. Previous studies have shown that higher levels of noise exposure are associated with higher morbidity and mortality of cardiovascular disease. It is estimated that people with hearing loss have 10-20% excess mortality. It has been suggested that noise exposure induces reaction of the autonomic nervous system and endocrine system, leading to increased secretion of the stress hormone, which in turn may lead to an increased risk of hypertension, coronary heart disease, and stroke **(Chen et al,2020).**

Other major health effects are lack of concentration, irritation, fatigue, headache, sleep disturbances **(Nandi & Dhatrak,2008).**

Older people with mild hearing loss have a two fold increased risk of dementia, whereas those with severe hearing loss have a five fold increased risk of dementia **(Chen et al,2020).**

It has been reported that ONIHL among workers has been significantly associated with an increased risk of work-related injuries. The suggested reasons for this finding are that higher noise levels obstruct the ability to hear warning signals, monitor equipment, react to environmental sounds, and coordinate with other workers **(Chen et al,2020).**
ONIHL does not directly cause premature mortality but does result in substantial disability. The impacts of occupational noise exposure cause a tremendous financial and disease burden on both individual and society. In the USA, it is estimated that the annual compensation for ONIHL is approximately $242.4 million. This economic burden on society is extremely high and continually increasing **(Chen et al,2020).**
The burden of hearing loss among noise-exposed workers varies by industry and occupation. **(Chen et al,2020).**
Studies on hearing in various professions suggest that hearing loss due to workplace noise was a significant problem since the 1960s and 1970s in industrialized countries, whereas hearing loss has been a less frequent problem in subsequent decades. The reduced occurrence of hearing loss is probably a result of decreased noise exposure, improved regulation and use of protective equipment, but the evidence for this is still limited. This positive trend does not apply to developing countries, where exposure to high levels of noise at work is still significant **(Lie et al,2016).**
One of the common industries in which workers are exposed to high noise levels is cable industry as reported by **(Hakim,2018)** that the most common exposures encountered among cable manufacturing workers were noise & accidents **(Hakim,2018).**
Therefore, this study is important as it will assess the prevalence of NIHL& its related risk factors among Egyptian cable industry workers and to provide effective recommendations to support their health.

SUBJECTS AND METHODS

A cross-sectional study was carried out among workers at two cable industry plants at 10^{th} of Ramadan city, Sharkia Governorate, Egypt during 2022-2023.

Study population
Determination of sample size and sampling technique

The sample size was calculated through Open-Epi version 3.01, according to the following data: Total number of workers involved in cable industry is 2359 workers, occupational noise exposure causes between 7 and 21 % of the hearing loss among workers **(Lie et al,2016)** with average taken (14%), confidence level = 95 %, confidence limits 5% So, the sample size was 170 workers.

Sample selection:
From total seven cable industry plants at 10^{th} of Ramadan city , 2 plants were selected randomly by simple random, and the number of workers in 1^{st} plant was 350 while the number in 2^{nd} plant was 170 so the number of selected workers was taken from each plant according to proportional allocation (2:1) >{ 113 from 1^{st} plant ,57 from 2^{nd} plant} and workers from each plant were selected randomly from sampling frame (using workers' list at each workplace) by simple random technique.
Pilot study was done using the semi-structured questionnaire on 10% of the sample who were excluded from the sample to test the response to different parts of the questionnaire, to test the feasibility of the study and to recognize the barriers that may arise during data collection. The results of the pilot study were not included in the results of the study. According to the results of the pilot study, the questionnaire was revised, and some modifications were done, mainly the length of the questions to be concise and removing the questions about the frequency and severity of symptoms as most of participants in pilot study could not determine them.

- **Inclusion criteria were as follows**: Workers who are involved in the process& exposed to its hazards and Willed to be involved in the study.
- **Exclusion criteria were as follows**: Administrative workers who are not involved in the steps of process and Workers refused to participate in the study.

Data collection tools
A) Pre-structured questionnaire was used to collect information from all participants about the following:
1. Personal and socio-demographic data including age, level of education, residence, marital status, and smoking habits.
*** Smoking habits included:**
Cigarettes: the number of cigarettes per day, number of packs per day, the duration of smoking& if stopped smoking, duration since stopped smoking.
Shisha*:* if the worker smokes shisha or not, and number of times of smoking per day, per week& duration of smoking in years.
2. Medical history of workers:

- General medical history of workers**:-**
  - Chronic diseases (hypertension, diabetes, cardiac, allergy to any substance, any other disease).
  - Diseases may affect hearing (measles, mumps, meningitis).

- Ototoxic drugs (salicylates, frusemide diuretics, Aminoglycosides).

3. Occupational history: which included: -

- Current occupation.

The working target group was differentiated into categories according to steps of the process;

1)- Drawing: Copper rods are too thick for usage in flexible wires so they undergone decreasing their thickness to reach desired diameter.

2)- Stranding: twisting of insulated cables or wires together to become more flexible.

3)- Insulation: the bare copper wires are insulated.

4)- Cabling: sheathing of cable according to different utilities.

- Duration of employment in current occupation.
- Number of working hours /day.
- Previous occupation.
- Duration of employment in previous occupation.
- Availability of rest hours.
- Availability of rest areas away from exposure.
- Availability of environmental monitoring.
- Availability of natural ventilation at workplace.
- Availability of air purifying methods at workplace.
- Opinion about workplace ventilation.
- Performance of pre-employment medical examination for workers.
- Performance of periodic medical examination for workers.
- Usage of personal protective equipment (safety helmet, mask, gloves, gown, goggles, ear plugs& muffs, safety shoes). If not, specify reasons of not using.

4-Symptoms of Auditory health problems:

Asking about Present history of Auditory problems

- Tinnitus or ringing sensation.
- Vertigo.
- Sensation of ear pressure or fullness at end of work shift.
- Difficulty in understanding speech of conversation.

It was translated into Arabic and then validated through a back translation technique and pilot testing.

B)- Audiometry:

Procedure:- Audiometry is a non-invasive and painless procedure to measure hearing sensitivity. The subject is made to sit in a sound treated room for testing. Standard headphones or the insert earphones are fixed. The hearing test is performed using sounds of single frequency, tested at various intensity levels and determining the lowest loudness level that the person is able to hear in each frequency. The subject is required to give a response on hearing a tone, like lifting hand or finger or pressing a button. The lowest loudness level heard by the subject in each frequency is recorded and is called Threshold. Thresholds are determined for tones with frequencies starting at about 125 Hz and increasing in frequency to about 8000 Hz.

Interpretation of NIHL:

A change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear is considered NIHL **(Moore et al.,2022).**

The first signs of NIHL can be observed in the typical 4000-Hz ‘‘notch’’ observed on audiograms, indicating a loss of hearing ability in the middle of the frequency range of human voices **(Nelson et al.,2005).**

The pre-designed questionnaire was submitted to a panel of experts in the field of occupational medicine for content language clarity, relevancy, and readability, ease of understanding, question sequence, and completion time as well as it was tested several times to test the reliability and calculate the reliability coefficients (Cronbach’s alpha) which were generally high (0.78) for all questionnaire parts, and suitable for scientific purposes.

DATA MANAGEMENT

The collected data were entered, checked, and statistically analyzed using SPSS program (Statistical Package for Social Science) version **26.0**. Qualitative data were represented as frequencies and percentages. Quantitative data were presented as mean and standard deviation. Non parametric data were presented by median and range. Median and range were used to describe number of cigarettes per day, smoking duration. Odds ratios (OR) and their 95% confidence intervals (95% CIs) were calculated using univariate analysis to measure the association between some sociodemographic, smoking, and occupational characteristics with problems identified among the workers. Binary logistic regression analysis was conducted to identify the predictors of each studied outcome. P-value < 0.05, was considered statistically significant and p-value < 0.01 was considered high statistically significant.

RESULTS

The studied workers mean age was (36.31± 9.47). Most workers (41.2%) were of age group (30 – < 40 years),(57.6%) from rural areas, (82.4%) were married, all of them (100%) had diploma education ,the majority (60.6%) were non smokers ,while (39.4%) were smokers with (52.2%) of them smoked less than 1 pack (20 cigarettes) per day and most of them (76.11%) smoked for duration (10 years or more).

Most workers worked in Drawing (44.1%) followed by insulation, cabling &stranding repectively (31.8,12.3,11.8%) and (59.4%) of them worked in current occupation for duration (10 years or more).

(56.5%) had previous occupation which is categorized in 3 main occupations; (53.1%) were working in battery manufacturing, (34.4%) in welding, (12.5%) in construction. (81.8%) of them had working duration of previous occupation less than 10 years **(Table 1).**

(100%) had (8) hours working /day in current occupation and reported availability of rest time and presence of environmental monitoring.

(100%) reported pre employment examination & periodic examination.

As regard PPE use, all workers reported using different types of PPE but not regularly. Workers reported using (Head Helmet, Mask, Gloves, Gown, Goggles, Ear Plugs & Muffs, Safety Shoes) by the following prevalence (90%,41.2%, 80%,31.2%, 68.2%, 84.7%, 100%) respectively.

As regard cause of non regular using of PPE, (75.9%) reported its use causing discomfort while (24.1%) reported it is not always available.

As regard medical history& family history of studied workers; the majority reported no chronic disease (82.4%), no chest disease (96.5%), no history of disease may affect hearing, (98.2%) no history of ototoxic drugs and (91.8%) no family history of Allergy. As regard auditory symptoms **(Table 2)**; (18.2%) reported tinnitus, (9.4%) vertigo, (15.9%) Ear pressure at end of work shift & (7.1%) Difficult understanding others speech. (38.2%) of studied workers had noise induced hearing loss by audiometric findings. As regard relation between positive audiometric results (NIHL) & sociodemographic characteristics; **Table(3)** shows that Age ($\geq$ 40) significantly related to development of NIHL. was

As regard occupational characteristics, factors significantly related to development of NIHL were current occupation (mainly Drawing), previous occupation & mask use **(Table4)**. By logistic regression analysis, the most significant predictor of occurrence of Noise induced hearing loss among studied workers was Current occupation (**Table 5**).

Table (1): Frequency distribution of Sociodemographic & occupational characteristics of the studied workers.

Variable	NO	%
Age (by years) (mean +/- SD)	**(36.31+/- 9.47)**	
▪ **20-**	**43**	**25.3**
▪ **30-**	**70**	**41.2**
▪ **40+**	**57**	**33.5**
Residence:		
▪ Rural	**98**	**57.6**
▪ Urban	**72**	**42.4**
Marital status:		
▪ Married	**140**	**82.4**
▪ unmarried	**30**	**17.6**
Education:	**170**	**100.0**
▪ diploma		
Smoking:		
▪ yes	**67**	**39.4**
▪ n**o**	**103**	**60.6**
No of cigarettes smoked /day Median (Min-Max)	**15 (1- 40)**	
▪ **< 1 pack**	**35**	**52.2**
▪ **1+**	**32**	**47.8**
duration of smoking (by years) Median (Min-Max)	**12 (1- 48)**	
▪ **< 10**	**16**	**23.9**
▪ **10+**	**51**	**76.11**
Current occupation		
▪ Drawing	**75**	**44.1**

▪ Stranding ▪ Insulation ▪ Cabling	**20** **54** **21**	**11.8** **31.8** **12.3**
no.of years employed in current occupation ▪ **< 5** ▪ **5 -** ▪ 10 +	 **20** **49** **101**	 **11.8** **28.8** **59.4**
Previous occupation ▪ NO ▪ **YES** **The following categories;-** Battery manufacturing Welding construction	**74** **96** **51** **33** **12**	**43.5** **56.5** **53.1** **34.4** **12.5**
Duration of previous occupation in years ▪ **< 10** ▪ **10 +**	**79** **17**	**81.8** **18.2**

Table (2): Frequency distribution of studied workers regarding Auditory symptoms and results of Audiometry.

Variable	NO	%
Tinnitus	**31**	**18.2**
Vertigo	**16**	**9.4**
Ear pressure at end of work shift	**27**	**15.9**
Difficult understand speech	**12**	**7.1**
Audiometry ▪ Noise induced hearing loss ▪ Normal	**65** **105**	**38.2** **61.8**

Table (3): Relation between positive Audiometric results &Sociodemographic characteristics.

Variable	Positive (NIHL) N= (65)		Negative N= (105)		COR (95% CI)	P value
	N	%	N	%		
Age Categories: ▪ **20-** ▪ **30-** ▪ **40+**	 **12** **21** **32**	 **27.9** **30.0** **56.1**	 **31** **49** **25**	 **72.1** **70.0** **43.9**	 **1.1(.4-2.5)** **3.3(1.4-7.7)**	 **.812** **.004**
smoking ▪ yes ▪ no	**24** **41**	**35.8** **39.8**	**43** **62**	**64.2** **60.2**	**.84(.42-1.67)**	**.601**
No of cigarettes smoked /day in packs ▪ **< 1** ▪ **1 +**	**16** **8**	**45.7** **25.0**	**19** **24**	**54.3** **75.0**	**.39(.14 - 1.12)**	**.077**

duration of smoking (in years) ▪ **< 10** ▪ **10 +**	**6** **18**	**37.5** **35.3**	**10** **33**	**62.5** **64.7**	**.9(.28-2.9)**	**.872**

Table (4): Relation between positive Audiometric results & Occupational history.

Variable	Positive N= (65)		Negative N= (105)		COR (95% CI)	P-value
	N	%	N	%		
Current occupation						
▪ Drawing	**42**	**56.0**	**33**	**44.0**	**4.4(2.02-9.7)**	**.00012**
▪ Stranding	**5**	**25.0**	**15**	**75.0**	**1.16(.35-3.8)**	**.793**
▪ Insulation	**12**	**22.2**	**42**	**77.8**	**.714(.22-2.24)**	**.563**
▪ Cabling	**6**	**28.6**	**15**	**71.4**		
no.of years employed in current occupation						
▪ **< 5**	**6**	**30.0**	**14**	**70.0**		
▪ **5 -**	**12**	**24.5**	**37**	**75.5**	**.75(.23 -2.4)**	**.636**
▪ **10 +**	**47**	**46.5**	**54**	**53.5**	**2.03(.7-5.7)**	**.173**
Previous occupation	**46**	**47.9**	**50**	**52.1**		
▪ Yes					**2.66 (1.3-5.1)**	**.003**
▪ no	**19**	**25.7**	**55**	**74.3**		
Duration of previous occupation						
▪ **< 10**	**39**	**49.4**	**40**	**50.6**	**.718(.24-2.07)**	**.540**
▪ **10 +**	**7**	**41.2**	**10**	**58.8**		
Rest places away from exposure areas						
▪ **Yes**	**56**	**37.8**	**92**	**62.2**	**1.13(.45-2.8)**	**.782**
▪ **no**	**9**	**40.9**	**13**	**59.1**		
Available Workplace ventilation						
▪ **Yes**	**49**	**39.5**	**75**	**60.5**	**.816(.4-1.6)**	**.573**
▪ **no**	**16**	**34.8**	**30**	**65.2**		
Air purifying methods						
▪ **Yes**	**49**	**39.5**	**75**	**60.5**	**.816(.4-1.6)**	**.573**
▪ **no**	**16**	**34.8**	**30**	**65.2**		
HEAD HELMET USE						
▪ **Yes**	**56**	**36.6**	**97**	**63.4**	**1.9(.7-5.3)**	**.188**
▪ **no**	**9**	**52.9**	**8**	**47.1**		
MASK USE						
▪ **Yes**	**19**	**27.1**	**51**	**72.9**	**2.2(1.18-4.4)**	**.013**
▪ **no**	**46**	**46.0**	**54**	**54.0**		
GLOVES USE						
▪ **Yes**	**51**	**37.5**	**85**	**62.5**	**1.16(.54-2.5)**	**.693**
▪ **no**	**14**	**41.2**	**20**	**58.8**		
GOWN USE						
▪ **Yes**	**21**	**39.6**	**32**	**60.4**	**.91(.47-1.7)**	**.802**
▪ **no**	**44**	**37.6**	**73**	**62.4**		
GOGGLES USE						
▪ **Yes**	**43**	**37.1**	**73**	**62.9**	**1.16(.6-2.26)**	**.646**
▪ **no**	**22**	**40.7**	**32**	**59.3**		

EAR PLUGS USE ▪ **Yes** ▪ **no**	**58** **7**	**40.3** **26.9**	**86** **19**	**59.7** **73.1**	**.54(.21-1.3)**	**.197**
SAFETY.SHOES USE	**65**	**38.2**	**105**	**61.8**	**-**	**-**
Cause if not used regularly: ▪ not available ▪ cause discomfort	**19** **46**	**46.3** **35.7**	**22** **83**	**53.7** **64.3**	**.64(.31-1.3)**	**.220**

Table (5): Binary forward logistic regression analysis for the significant predictors of occurrence of Noise induced hearing loss among studied workers.

Variables	B	S.E	Wald	OR (CI 95%)	P-value
Current occupation: ▪ Drawing ▪ Stranding ▪ Insulation ▪ Cabling	 **1.157** **- .182** **- .336** **- .916**	 **.536** **.707** **.584** **.483**	 **4.661** **.066** **.333** **3.598**	 **3.182** **.833** **.714** **.400**	**.001** **.031** **.797** **.564** **.058**

DISCUSSION

The largest burden of NIHL has been attributed to occupational exposures especially industries like cable industry which is considered a hazardous occupation that expose its workers to high noise levels but there is scarcity of research about it so this study is important to determine the prevalence of NIHL among cable industry workers.

As cable industry is a risky occupation with the most common exposure encountered was noise as stated by **(Hakim,2018).** Workers at present study; (18.2%) of them reported tinnitus, (9.4%) vertigo, (15.9%)ear pressure at end of work shift, (7.1%) difficult understanding others speech and (19.4%) reported having at least one symptom as shown in Table(2). In comparison with **(Rahman et al,2022)**, stated that manufacturing workers who reported noise induced auditory symptoms were a low number as (6.4%)reported tinnitus, (10.5%) experienced ear fullness after leaving noisy area, while (8.1%) had difficulty understanding people talking after noise exposure and (18%) reported having at least one symptom.

Unlike a previous study among factory workers exposed to high levels of noise where higher prevalence of workers (30.86%) had illness like ringing and leakage in the ears as well as hearing loss **(Atmaca et al,2005).** That in agreement with **(Mostafa et al,2019)** who reported that (28%) of noise exposed workers suffered tinnitus and (26%) had earache. As well as **(Abdel-Rasoul et al, 2013)** reported that exposed group of workers to high noise levels experienced a significant higher prevalence of all auditory manifestations. Moreover, **(Stephen et al, 2013)** reported that more than half (63.3%) of workers who were exposed to noise levels beyond recommended, cannot hear words clearly at normal conversation.

(38.2%) of studied workers suffered noise induced hearing loss (NIHL) by Audiometric findings, which is a prevalence higher than reported by **(Abdel-Rasoul et al,2016)** as (17.8%) of exposed workers to high noise levels had hearing impairment and v- dip depression found in (65.6%) of them. Another study revealed (26.8%) of high noise exposed workers at glass factory had hearing impairment **(Abdel-Rasoul et al,2013),**While **(Atmaca et al,2005)** reported that (30.86%) of high noise levels exposed workers had hearing loss.In comparison with previous studies reported higher prevalence of NIHL, **(Jamal et al,2016)** reported (61.2%) of exposed workers had hearing loss which in agreement with **(Khalifa&Shehata,2020)** who stated that most workers (61.5%) of exposed group to high levels of noise suffered from hearing impairment.

In the present study as shown in Table(1), mean age of studied workers at cable factory was (36.3± 9.47) which is nearly in agreement with **(Hakim,2018)** who stated that mean age of Workers at cable factory was (34.5± 9.30) and

(Attrachi et al,2014) stated that workers of cable manufacturing company mean age was (38.5± 4.72). In comparison with a previous study where mean age of cable splicers was (30.3± 5.4) & cable manufacturers mean age was (41.0± 11.8) **(Fischbein et al,1980).** All of our studied workers (100%) had education level diploma as this is the common level of education of this working community. In comparison with a previous study where (37.7%) of cable factory workers completed primary school, (28.7%) higher school, (21.3%) don't read or write and the other (12.3%) had university education **(Hakim,2018) a**nd **(Mostafa et al,2019)** who stated that Egyptian workers at factory of same exposure to high noise levels;(90%) were educated otherwise (10%) not educated.

(39.4%) of our studied workers were smokers. In comparison with workers at cable manufacturing company where smokers were (21.3%) **(Attrachi et al,2014).** However**, (Mostafa et al,2019)** reported exposed workers at same exposure factory where smokers were (34%).

Most workers were of 2 categories of current occupation (Drawing & Insulation) by (44.1%,31.8%) respectively as the number of workers required for these 2 steps of the process is larger than other steps. With number of years employed in current occupation (10 years or more) by (59.4%), and all of them worked 8 hours per day which in concordance with **(Mostafa et al,2019)**who stated that all workers worked 8 hours daily for 6 days/week with total work duration ranged (2-35years).Also the same working hours reported by **(Hakim,2018)** as mean working hours/day (7.89 ±.61).While **(Attrachi et al,2014)** reported workers of cable company duration of work ranged (1-23years).

All studied workers reported pre employment examination (PEE) & periodic examination in comparison with a previous study at cable factory stated that only (43.4%) of workers had PEE & only (16.4%) had periodic examination **(Hakim,2018)**. However**, (Stephen et al,2013)** reported that (55.1%) of workers exposed to high noise levels had regular medical check up. Studied workers reported wearing different types of personal protective equipment (PPE) including (Head helmet, mask, gloves, gown, goggles, earplugs& muffs, safety shoes) by the following prevalence respectively (90%, 41.2%, 80%, 31.2%, 68.2%, 84.7%, 100%) which in comparison with a previous study reported factory workers of same exposure to high noise levels used (gloves, mask, uniform, boots) as (60%, 56%, 56%, 26%) respectively **(Mostafa et al,2019)** and rate of using hearing protective device among noise exposed workers was (32.94%) **(Atmaca et al,2005).** Whereas another study at cable factory reported that (18.9%) of workers were using PPE **(Hakim,2018).**

However **(Rahman et al,2022)** reported (50.2%) of noise exposed workers not wearing hearing protection device(HPD) at work.

As regard cause of non regular using PPE, (75.9%) of workers reported that their use causing annoying & discomfort and (24.1%) reported that PPE not always available at workplace which is lower prevalence than a previous study revealed that (63.1%) of workers were not provided by(HPD) at work while (59%) not receiving PPE training at work **(Rahman et al,2022).**

In current study, most workers (82.4%) reported no chronic diseases, (96.5%) reported no chest troubles, (91.8%) no family history of allergy and (98.2%) no history of ototoxic drugs intake or history of diseases may affect hearing as these factors may confound any reported positive health problems in agreement with **(Azizi,2010)** who reported that history of previous ear diseases, taking ototoxic drugs, smoking and hypertension were significantly associated with hearing status of workers.

On relation between NIHL& Sociodemographic charachteristics of studied workers (Table 3), as regard age, there was statistically significant relation with NIHL that in agreement with a previous study stated that age was significantly related to NIHL **(Jamal et al,2016)** and **(Pyykkö et al,2007)** reported that the elderly subjects were more susceptible to NIHL than younger subjects. Moreover **(Azizi et al,2010)** reported that age was important factor in development of NIHL. Age is a significant predictor of NIHL **(Ammar et al,2022)**.

As regard smoking, it was not significantly related to NIHL which is in agreement with **(Jamal et al,2016)** that reported weak relationship between smoking& NIHL. However, **(Mohammadi et al,2010)** reported NIHL higher frequency in smokers compared to non smokers. Smoking related to NIHL **(Pyykkö et al,2007).** Smoking was significantly associated with NIHL **(Azizi et al,2010)**.This difference may be explained by deliberately hiding of smoking by workers due to fear of losing their jobs.

As regard current occupation at cable factory, it showed high statistically significant relationship with NIHL and by regression analysis it was the most significant predictor for occurrence of NIHL (Table 5) ; which is consistent with **(Hakim,2018)** who stated that the most common exposure encountered by cable manufacturing workers was noise.

Working duration was not significantly related to NIHL which is in agreement with **(Jamal et al,2016)** who reported that there was not statistically significant relationship between work duration& NIHL(p=.39). As well as **(Atmaca et**

al,2005) reported no significant relationship between working periods& NIHL. Unlike **(Ammar et al, 2022)** who reported working duration as significant predictor of NIHL.

As regard previous occupational exposure, it is significantly related to NIHL which may be attributed to lead exposure as studies reported an association between lead exposure and impaired conduction at auditory nerve as **(Farahat et al,1997)** reported significant correlation between BLL& hearing threshold. The exposed workers (mean 37µg/dL) had significantly elevated hearing thresholds **(Johnson&Morata,2010)**.

Even may be explained by previous noise exposure as additive effect.

As regard PPE use, non wearing mask significantly related to NIHL.

Which in concordance with **(Azizi et al,2010)** who stated that using of HPD was significantly related to hearing status of workers. That with agreement to **(Nuaim et al,2015)** who concluded that the workers were protected from noise exposure by wearing ear plugs. Moreover **(Pelegrin et al,2015)** found by regression analysis that the use of hearing protective measures at work was a significant predictor of NIHL in exposed workers.

CONCLUSION

Cable industry is considered one of the dangerous industries that involving many hazards to which workers are exposed, of the most common risks is the high prevalence of occupational deafness. Therefore, attention must be directed to this important industry with many preventive measures and obligatory laws in order to protect workers from NIHL, improve their health and guarantee their right to live a better and more productive life.

RECOMMENDATIONS

Engineering measures:

- Modifying or replacing equipment and using quieter machines.
- Enclosing or isolating noise source by placing a barrier between the noise source and employee.
- Vibration Isolation Pads for Vibration control, employing anti-vibration machine mounts such as springs or neoprene will reduce transmission of noise created by vibration.
- Regular maintaining and lubricating machines.

Administrative measures:

Employers must make changes in the workplace or schedule that reduce or eliminate the worker exposure to noise like:

- Operate noisy machines during shifts when fewer people are exposed
- Limit the amount of time a person spends at a noise source.
- Provide quiet areas where workers can gain relief from hazardous noise sources.
- Control noise exposure through distance is often an effective, yet simple and inexpensive administrative control.

Concerned governmental authorities:

- Must perform periodic checking & survillence of workplace to ensure that noise level is maintained within permissible exposure limits.
- Obligatory laws for employers to provide required PPE for exposed workers with ensuring its continous availability & training workers on correct using and cleaning it.
- Ensuring availability of properly designed PPE suitable for climatic working conditions and reduce discomfort of the workers.

Medical measures: by **r**aising awareness by applying compulsory health education programs for exposed workers about the health hazards to which they are exposed and how to protect themselves.

STUDY LIMITATIONS

This study has some limitations. First: This study has been conducted among cable workers at 10^{th} of Ramadan city in Egypt so results cannot be generalized over all cable industry workers in different workplaces. Second: The information bias can't be excluded as the data on sociodemographic, smoking, occupational charachteristics and symptoms of auditory health problems were derived from the questionnaires.

ETHICAL CONSIDERATIONS:

The study protocol was approved by the Research Ethics Committee of the Faculty of Medicine, Zagazig University. Entrance to cable industry plants to conduct the study was welcomed, and verbal permission was given by managers of workplaces. Ethical considerations and confdentiality were respected. Consent to participate An informed consent was obtained from all participants of this study. The participants were told about the study's aim, and they were informed that the data would be used for scientifc purposes only. The participants were also given the right to refuse or participate in the study.

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Consent to Publish: Not applicable**.**

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