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## Factors influencing the use of hearing protection devices in Irish mine workers

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### Abstract

**Background:** Workers who are exposed to high levels of noise should consider wearing HPDs when elimination of noise cannot be put in place. There are several factors including health and safety management systems, peers and policy that could influence workers to either use or not use HPDs. **Objectives:** To determine worker's perception of noise risk in a mining setting and to determine if there is an association between organisational rules, knowledge, and the wearing of Hearing Protection Devices (HPDs). **Methods:** A cross-sectional study was conducted at a mining setting in Ireland in which 116 workers participated; a self-administered questionnaire survey was used. Data analysis was carried out using descriptive statistics and binary regression analysis. **Results:** The study had a response rate of 94% of the entire population. The mean exposure to noise levels that require HPDs is 5.32 hours. The results showed an association between using HPDs and organisation rules; and no association between preventing abnormal hearing, perceived influences in the workplace, knowledge and information. **Conclusion:** Factors that can influence workers likelihood to wear HPDs are organisation rules; this is unaffected by the influence of colleagues. Each company should have a clear policy to encourage workers to wear HPDs for preventing Noise Induced Hearing Loss (NIHL). **Application:** The findings highlighted that a company's health and safety policy is important to encourage employees to wear HPDs. Mine settings or noisy workplaces should have transparent policies for employees to follow and benefit their hearing health, even if an employee is not aware of the full content of a policy, aspects are known.

## 1. INTRODUCTION

The effects of occupational noise exposure in workers can go unnoticed by workers in the early years. NIHL is irreversible and permanent, once hair cells in the ear are damaged, they cannot be regenerated. NIHL influencing factors to take into consideration include career length, health-related behaviour, and the poor use of Personal Protective Equipment (PPE). Along with the financial costs, NIHL also significantly affects human suffering, quality of life, personal safety, and social interaction.

NIHL is a significant occupational health problem worldwide (Kerns et al., 2018; Yali et al., 2019; Shin et al., 2020). In situations where Hearing Conservation Programs (HCP) have not been able to reduce occupational noise exposure to a suitable level, HPDs should be worn by workers, and they should have regular hearing health checks. Interventions to prevent NIHL is important; one single strategy is not sufficient to

prevent NIHL. Safety awareness can play a key role in using HPDs (Alnuman and Ghnimat, 2019), as with risk perception that can influence worker's use of the HPD. Companies with more rigorous safety procedures presented a greater effective use of HPDs in workers (Wictor and Xavier, 2018).

Management's commitment to workers is reflected within the culture of the workplace. Safety management not only improves working conditions but also influences employees' behaviour and attitudes in the workplace. Studies found that safety leadership, attitude, safety motivation can influence workers participation and compliance (Abdulrahman, 2021; Wang et al., 2021). Additionally, a positive attitude and health and safety training present an association to noise reduction in the workplace (Israel et al., 2020).

Employee's knowledge of hearing impairment improves their safety performance. Work performance integrated with health and safety management are important to improve safety performance in employees (Edmund et al., 2021). Workplaces with a strong safety culture and that provide practical health and safety management are associated with greater adherence to wearing HPDs. There is a positive association between HPD use, training, years of service, education levels, gender, and type of HPD (Thepaksorn et al., 2018; Chien-Chen and Terng-Jou, 2020).

Comfort and correct fitting of HPDs is one important factor when employees are required to wear them while working in high noise levels for long durations. Although employees wear HPDs, if the devices are not properly fitted it can be harmful to employees both mentally and physically, rather than protecting health.

Hypotheses for the study were: (a) mine workers are more likely to wear HPDs with increased years of employment or duration exposure to occupational noise, (b) personal discomfort is a factor in adherence to wearing HPDs, and (c) organisation rules and information provided to mine workers influence the wearing of HPDs.

The objectives of the study were to determine workers' perception of occupational noise risk in their workplace (i.e., a mining setting in Ireland) and determine if there is an association between organisational rules and their willingness to wear HPDs.

## 2. MATERIAL AND METHODS

The study population consisted of workers exposed to high noise levels in an Irish gypsum extraction facility. This includes workers in an underground mine, quarry, plasterboard and plaster manufacturing facility. The organisation is also a supplier of gypsum rock to the cement manufacturing industry. The quarry is one of several Irish quarries supplying material for construction and road aggregates.

There were 128 participants in this study. A total of 124 were eligible, with 8 of these returning a blank questionnaire resulting in a total study population of 116. The inclusion criteria involved all workers, except for workers in the company for less than 3 months, temporary workers, and students on placement/ work experience. The level of education data was not collected in this study. However, most workers have achieved secondary school education. Workers take part in bi-annual noise conservation training provided by an accredited external contractor.

A cross-sectional study based on a self-reported questionnaire was used for this study. The survey was developed from a previous study related to noise and HPDs carried out by Thantranont (2017). There were two parts in the questionnaire; part one included demographic data (job role, gender, age, duration working for the company and duration of exposure to noise levels that requires HPDs); part two included questions about influencing factors and use of HPDs (preventing abnormal hearing, preventing noise annoyance, personal discomfort, communication interference, perceived influencers, organisation rules, knowledge and information, and monitoring and hearing tests).

In part two, questions were asked on a 5-point scale with answer options on a Likert scale: "strongly disagree", "disagree", "neither agree nor disagree", "agree", and "strongly agree". When analysis took place, the scales were made into 3 points by

combining strongly disagree and disagree into disagree, neither agree or disagree, and combining agree or strongly agree into agree.

Data entry and analysis was performed using IBM Statistical Package for Social Sciences (SPSS 26). Descriptive results, chi square test, and binary regression analysis were used to determine the association between using HPDs and perception in participants. Statistical significance analyses were used to explore and describe the variables influencing the wearing of HPDs. Results were considered significant where p-value was equal to or less than 0.05.

A Chi square test was used to analyse the association between using HPDs and personal perceptions based on personal factors; age (grouped into less than or equal to 35 years old and more than 35 years old); duration of exposure to noise (less than or equal to 4 hours, more than 4 hours); duration working for the company (less than or equal to 10 years, more than 10 years); hours per day wearing HPDs (less than or equal to 6 hours, more than 6 hours).

A pilot study was conducted prior to data collection to ensure clarity of the questions and content. The pilot study involved 15 participants and their comments on the questions were collected and considered in rewriting the questionnaire. The pilot study formed part of the study population. After the pilot study, the questions were reviewed and reformatted. All returned surveys were verified for completeness during data cleansing and incomplete questionnaires (n = 8) were discarded. Ethics exemption was sought and granted by University College Dublin (UCD) Taught Masters Ethics committee.

### 3. RESULTS

Of the 128 workers invited to participate in this study, 124 participated, out of these the total study population ended up being 116 as 8 returned blank questionnaires. The study had a response rate of 94% of the entire population. The mean age of the population is  $43.9 \pm 11.4$  years and mean years of employment is  $14.9 \pm 13.9$ , the mean exposure to noise levels that require HPDs is  $5.3 \pm 4.0$  hours. The research population was male dominated (87.1%), 64.7% of the workers are 35 years of age or older versus 21.5% under 35 years and some preferred not to say. The characteristics of the study population including role and teams are presented in [Table 1](#).

**Table 1.** Population characteristics

Variable	n	%
<b>Team</b>		
Board Plant	26	22.4
Plaster Mill	15	12.9
Mine/ Quarry	20	17.2
Supply Chain	27	23.3
Engineering	26	22.4
Office	2	1.7
Total	116	100.0
<b>Role</b>		
Contractor	2	1.7
(Exposed to high noise levels)		
Manager	10	8.6
Operator/ Craft	77	66.4
Team Leader/ Supervisor	11	9.5
Staff/ Clerical	10	8.6
Missing	6	5.2
Total	116	100.0

<b>Variable</b>	<b>n</b>	<b>%</b>
<b>Gender</b>		
Male	101	87.1
Female	5	4.3
Missing	10	8.6
Total	116	100.0
<b>Age (years)</b>		
21 – 25	3	2.6
26 – 30	7	6.0
31 – 35	15	12.9
>35	75	64.7
Missing	16	13.8
Total	116	100.0
<b>Mean ± SD</b>	<b>43.9 ± 11.4</b>	
<b>Duration working for the company (years)</b>		
≤ 5	40	34.5
6 – 10	9	7.8
11 – 15	15	12.9
16 – 20	14	12.1
21 – 25	3	2.6
>25	21	18.1
Missing	14	12.1
Total	116	
<b>Mean ± SD</b>	<b>14.9 ± 13.9</b>	
<b>Hours in a day that requires the wearing of HPDs</b>		
≤ 2	35	30.2
>2-4	20	17.2
>4-6	19	16.4
>6	36	31.0
Missing	6	5.2
Total	116	100.0
<b>Mean ± SD</b>	<b>5.3 ± 4.0</b>	

Table 2 presents the descriptive data of what was studied regarding what employees believe about wearing HPDs and organisation variables. Most of the participants agree that wearing HPDs, prevent abnormal hearing, prevents noise annoyance, and depends on organisation HPDs rules and information provided. Results of Table 2 demonstrated that 94.8% agree that using HPDs can protect hearing from occupational noise exposure, 81.9% agreed that their co-workers use HPDs through the working day in loud noise areas and 79.3% employees use HPDs when the safety information is provided via team talks.

Association between personal factors and perceptions of using HPD were studied. Organisation rules and information provided by the organisation showed an association with the wearing of HPDs, that was not influenced by how long the employee has been

working for the company or the duration wearing HPDs. Whereas age and duration of exposure to noise showed no association with the wearing of HPDs by workers.

**Table 2.** Employee beliefs about HPD and organisational variables

	Strongly Disagree / Disagree		Neither Agree or Disagree		Agree / Strongly Agree		Total	
	n	%	n	%	n	%	N	%
<b>Preventing abnormal hearing using HPDs</b>								
You believe that using HPDs can prevent tinnitus caused by loud noise.	1	0.6	10	8.6	105	90.5	116	100.0
You believe that using HPDs can prevent difficulty in hearing caused by loud noise.	2	1.7	6	5.2	108	91.4	116	100.0
You believe that using HPDs can prevent deafness from loud noise (Missing n=1).	2	1.7	11	9.5	102	87.9	115	99.1
You believe that using HPDs can protect your hearing.	1	0.9	5	4.3	110	94.8	116	100.0
<b>Perceived HPD-use influencers</b>								
Co-workers use HPDs through the working day in loud noise areas (Missing n=3).	8	6.9	10	8.6	95	81.9	113	97.4
Supervisors warn workers about not wearing HPDs (Missing n=5).	18	15.5	16	13.8	77	66.4	111	95.7
Supervisors urge workers to regularly use HPDs by checking them during the working day (Missing n=5).	21	18.1	32	27.6	58	50.0	111	95.7
Supervisors praise and give rewards when workers use HPDs while working (Missing n=7).	40	34.5	42	36.2	27	23.3	109	94.0
Supervisors use HPDs all the time in loud areas (Missing n=3).	23	19.8	23	19.8	67	57.8	113	97.4
<b>Organisation HPD rules</b>								
The organisation requires that workers use HPDs every time when working in loud noise areas (Missing n=3).	5	4.3	10	8.6	98	84.5	113	97.4
The organisation puts warning signs up all the time to urge workers to use HPDs while working (Missing n=3).	8	6.9	9	7.8	96	82.8	113	97.4
The organisation has disciplinary action in the event of not using HPDs (Missing n=6).	38	32.8	33	28.4	39	33.6	110	94.8
Every worker who works in loud noise areas receives HPDs (Missing n=3).	10	8.6	8	6.9	95	81.9	113	97.4
<b>HPD knowledge and information</b>								
HPD training is provided by the organisation (Missing n=4).	35	30.2	18	15.5	59	50.9	112	96.6
Safety posters are provided throughout the organisation (Missing n=3).	10	8.6	13	11.2	90	77.6	113	97.4
Safety information is provided via brochures/handouts. (Missing n=3).	27	23.3	23	19.8	63	54.3	113	97.4
Safety information is provided via team talks (Missing n=3).	12	10.3	9	7.8	92	79.3	113	97.4
Safety information is provided via supervisors' and workers' meetings (Missing n=3).	14	12.1	17	14.7	82	70.7	113	97.4

There was no relationship between knowledge of knowing HPDs can prevent abnormal hearing and influence from colleagues. Results of association between personal factors and perception of wearing HPDs are shown in [Table 3](#).

**Table 3.** Association between organisational rules, knowledge and information variables and perception of wearing HPDs

Variables	Age (Years)			Duration of exposure to noise (Hours)			Duration working for the company (Years)			Hours per day wearing HPDs		
	≤35	>35	P-value	≤ 4	> 4	P-value	≤ 10	>10	P-value	≤ 6	> 6	P-value
<b>Organisation rules</b>												
The organisation requires that workers use HPDs every time when working in loud noise areas.												
Agree (n,%)	35 (31)	63 (55.8)	0.98	51 (45.1)	47 (41.6)	0.09	43 (42.6)	48 (47.5)	0.87	67 (62)	29 (26.9)	0.1
Disagree (n,%)	5 (4.4)	10 (8.8)		4 (3.5)	11 (9.7)		5 (5.0)	5 (5)		5 (4.6)	7 (6.5)	
The organisation puts warning signs up all the time to urge workers to use HPDs while working.												
Agree (n,%)	33 (29.2)	63 (55.8)	0.59	49 (43.4)	47 (41.6)	0.29	43 (42.6)	47 (46.5)	0.88	62 (57.4)	31 (28.7)	0.62
Disagree (n,%)	7 (6.2)	10 (8.8)		6 (5.3)	11 (9.7)		5 (5)	6 (5.9)		10 (9.3)	5 (4.6)	
The organisation has disciplinary action in the event of not using HPDs.												
Agree (n,%)	12 (10.9)	27 (24.5)	0.36	19 (17.3)	20 (18.2)	0.95	21 (21.2)	18 (18.2)	0.38	25 (23.8)	13 (12.4)	0.76
Disagree (n,%)	28 (25.5)	43 (39.1)		35 (31.8)	36 (32.7)		27 (27.3)	33 (33.3)		46 (43.8)	21 (20.0)	
Every worker who works in loud noise areas receives HPDs.												
Agree (n,%)	34 (30.1)	61 (54.0)	0.84	49 (43.4)	46 (40.7)	0.15	43 (42.6)	45 (44.6)	0.48	65 (60.2)	26 (24.1)	<b>0.01</b>
Disagree (n,%)	6 (5.3)	12 (10.6)		6 (5.3)	12 (10.6)		5 (5.0)	8 (7.9)		7 (6.5)	10 (9.3)	
<b>Knowledge and information</b>												
HPD training is provided by the organisation.												
Agree (n,%)	17 (15.2)	42 (37.5)	0.10	33 (29.5)	26 (23.2)	0.12	24 (24.0)	34 (34.0)	0.11	39 (36.4)	17 (15.9)	0.58
Disagree (n,%)	23 (20.5)	30 (26.8)		22 (19.6)	31 (27.7)		24 (24.0)	18 (18.0)		33 (30.8)	18 (16.8)	
Safety posters are provided throughout the organisation.												
Agree (n,%)	34 (30.1)	56 (49.6)	0.29	46 (40.7)	44 (38.9)	0.30	39 (38.6)	43 (42.6)	0.98	60 (55.6)	27 (25)	0.30
Disagree (n,%)	6 (5.3)	17 (15)		9 (8)	14 (12.4)		9 (8.9)	10 (9.9)		12 (11.1)	9 (8.3)	
Safety information is provided via brochures/ handouts.												
Agree (n,%)	21 (18.6)	42 (37.2)	0.60	34 (30.1)	29 (25.7)	0.20	22 (21.8)	36 (35.6)	<b>0.02</b>	42 (38.9)	20 (18.5)	0.78
Disagree (n,%)	19 (16.8)	31 (27.4)		21 (18.6)	29 (25.7)		26 (25.7)	17 (16.8)		30 (27.8)	16 (14.8)	
Safety information is provided via team talks.												
Agree (n,%)	32 (28.3)	60 (53.1)	0.77	46 (40.7)	46 (40.7)	0.55	37 (36.6)	46 (45.5)	0.20	59 (54.6)	30 (27.8)	0.85
Disagree (n,%)	8 (7.1)	13 (11.5)		9 (8.0)	12 (10.6)		11 (10.9)	7 (6.9)		13 (12)	6 (5.6)	
Safety information is provided via supervisors' and workers' meetings.												
Agree (n,%)	29 (25.7)	53 (46.9)	0.99	44 (38.9)	38 (33.6)	0.08	33 (32.7)	43 (42.6)	0.15	55 (50.9)	25 (23.1)	0.43
Disagree (n,%)	11 (9.7)	20 (17.7)		11 (9.7)	20 (17.7)		15 (14.9)	10 (9.9)		17 (15.7)	11 (10.2)	

The association between personal perception and whether employees agree or disagree on wearing HPDs was studied. The results in Table 4 show association between using HPDs and organisation rules when the organisation requires workers to use HPDs every time when working in loud noise areas (adj OR 4.87, 95%CI (1.12 to 21.14)), and when workers that work in loud noise areas receive HPDs (adj OR 4.54, 95%CI (1.25 to 16.46)). No association between perceived influences in the workplace, knowledge and information.

**Table 4.** Association between wearing HPDs and workers personal perception

	Wearing HPDs	HPDs*	HPDs**	HPDs***
	Crude OR, 95% CI	Adj OR, 95% CI	Adj OR, 95% CI	Adj OR, 95% CI
<b>Organisation rules</b>				
The organisation requires that workers use HPDs every time when working in loud noise areas.	4.32 (1.36 to 13.72)	4.58 (1.39 to 15.14)	5.24 (1.24 to 22.17)	4.87 (1.12 to 21.14)
The organisation puts warning signs up all the time to urge workers to use HPDs while working.	1.28 (0.45 to 3.66)	1.38 (0.46 to 4.09)	1.57 (0.44 to 5.65)	1.55 (0.42 to 5.72)
The organisation has disciplinary action in the event of not using HPDs.	0.97 (0.43 to 2.19)	1.05 (0.45 to 2.42)	0.85 (0.36 to 2.01)	0.88 (0.37 to 2.12)
Every worker who works in loud noise areas receives HPDs.	3.4 (1.20 to 9.65)	3.55 (1.21 to 10.41)	4.93 (1.38 to 17.59)	4.54 (1.25 to 16.46)
In the event HPD is damaged or does not fit, you can exchange for new ones all the time.	1.91 (0.62 to 5.89)	2.17 (0.67 to 7.01)	3.21 (0.71 to 14.47)	2.84 (0.61 to 13.08)
In the event HPD is lost, you can get new ones all the time.	1.45 (0.37 to 5.73)	1.87 (0.44 to 7.90)	1.65 (0.21 to 12.50)	1.34 (0.17 to 10.13)
<b>Knowledge and information</b>				
HPD training is provided by the organisation.	1.18 (0.54 to 2.56)	1.37 (0.61 to 3.07)	1.14 (0.49 to 2.68)	1.17 (0.49 to 2.80)
Safety posters are provided throughout the organisation.	1.83 (0.72 to 4.63)	1.68 (0.65 to 4.35)	1.40 (0.50 to 3.93)	1.27 (0.44 to 3.62)
Safety information is provided via brochures/ handouts.	1.33 (0.61 to 2.88)	1.41 (0.64 to 3.13)	1.29 (0.55 to 3.04)	1.17 (0.49 to 2.82)
Safety information is provided via team talks.	1.10 (0.41 to 2.92)	1.14 (0.41 to 3.11)	0.96 (0.32 to 2.88)	0.86 (0.28 to 2.64)
Safety information is provided via supervisors' and workers' meetings.	1.67 (0.72 to 3.90)	1.71 (0.72 to 4.10)	1.80 (0.69 to 4.65)	1.65 (0.62 to 4.35)

\* Adjusted for age, \*\* adjusted for duration of working for the company, \*\*\* adjusted for age and duration of working for the company

## 4. DISCUSSION

### 4.1. Findings summary

The major sources of occupational noise in the study include heavy plant and machinery, loading and unloading of raw materials and blasting conducted in the underground mine. Blasting is conducted at specific times with no workers present in the area. Extraneous noise sources included roadway traffic adjacent to the facilities. Most of the participants were male which is attributed to the nature of the work.

The average age of participants was greater than 35 years old, with long service working for the company, and they are required to wear HPDs for more than 6 hours a day. Participants were aware of the importance of wearing HPDs during work. The results show an association between organisation rules, knowledge and information provided.

The participants in this study reported strong adherence to the wearing of HPDs when they must work in a noisy area, when HPDs are available or when they are being supervised by their supervisor. Eighty four percent of workers agree that organisation

requires workers to use HPDs when working in high noise areas, and 81.9% agree they are provided with HPDs.

#### 4.2. Perception towards HPDs

In the hierarchy of controls, using HPDs is recommended to be the last resort. However, as due to the nature of some tasks it is not possible to avoid risk or re-design, it means that HPDs are still important. We found that the workers in this study understand the reasons why they were being asked to wear HPDs, but they do not wear them because of personal reasons or discomfort with the equipment, rather than because the supervisor praises and gives rewards when workers use HPDs while working or because the organisation takes disciplinary action in the event of not using HPDs. It is interesting that peer pressure is not an influence on workers in the study which is in contrast to other studies that wearing HPDs seems to be influenced by co-workers and supervisors due to high adherence to wearing HPDs (Bockstael, 2013; Thantranont and Codchanak, 2017; Abdulrahman, 2021; Wang et al., 2021).

There are several factors influencing the wearing of HPDs. Health and safety professionals can be an extension of management in the workplace and influence workers to wear HPDs (Bockstael, 2013; Abdulrahman, 2021). Studies found a positive association between the use of HPDs and training and years of service (Thantranont and Codchanak, 2017) educational levels and gender should be considered as factors in the usage of HPDs (Meira et al., 2015; Alnuman and Ghnimat, 2019). These studies found that there was an association between the use of HPDs and noise hearing prevention. These findings will benefit companies in improving the adherence of workers wearing HPDs in high occupational noise exposure working environments.

#### 4.3. Barrier of using HPDs at work

There are several barriers for PPE usage in the workplace including the absence or deficiency of training, age of the worker, fitting, lack of comfort and job competence (Aiggan et al., 2020; Chien-Chen and Terng-Jou, 2020). This can lead to a lack of hazard awareness in the workplace resulting in the worker only wearing PPE for short durations throughout the day.

Education and duration of employment were significantly associated with the awareness of the need to wear PPE (Budkathoki et al., 2014), and awareness of workplace hazards was associated with age and working hours per day (Ahmad, 2017). From this study, workers demonstrated that they know and understand the risks from exposure to high noise levels. However, it does not matter if workers are older or have a long history working for the company, they will wear HPDs if the company provides PPE or have safety rules. This is similar to a study that found PPE utilisation among workers was low and the main reason was PPE unavailability, lack of safety training, and the absence of orientation on using PPE (Alehegn et al., 2020). The associations demonstrate that a good company policy, training and PPE availability influences workers to wear HPDs to protect their health.

The comfort of HPDs could be an issue if the organisation would like to enforce workers to wear them during exposure to high noise levels. However, the comfort of any HPD is subject to personal factors and preferences and so it might be worthwhile for the organisation to survey the different types of HPDs including materials and sizes of HPDs to give more selection to workers. Aliabadi and team (2015) suggests that the perfect HPD should be chosen by the worker. This study workers demonstrated a high adherence to wearing HPDs. Providing well-fitting HPDs alone does not mean that the HPDs will reduce the noise level, employees must use them correctly and therefore fitting and training on the use of HPDs is deemed to be necessary (Wei et al., 2019; Federman et al., 2021).

#### 4.4. Company policy and the wearing of HPDs

The study has shown that a company health and safety policy is important to encourage the wearing of HPDs which is similar to another study by Tristiana (2020). Haslinda (2016) argues that even when a worker is not aware of the presence of a policy it will minimise unsafe behaviours in the workplace. The worker is aware of specific aspects of that policy. This can be shown as workers agreed on aspects of the policy such as organisation rules and supply of HPDs in the workplace. The promotion of training is also important to ensure organisational rules are known and HPDs are worn effectively (Reddy et al., 2012).

The study suggested that the use of policy to encourage employees to wear HPDs is vital. Our study showed similar results to the study which found an association between occupational noise and regulation (Royster, 2017), not inclusive of agricultural workers. They found that the regulations have an impact on increasing the use of HPDs and medical surveillance. This might be related to employees' fear of losing employment. A company policy can influence workers in a mining setting to wear HPDs, the safety rules or regulations should not change all the time and not be too detailed (Hale et al., 2015).

This may be because mine workers cannot follow all instructions and subsequently, they may ignore all working rules eventually. Therefore, to encourage workers to follow health and safety regulations, a positively enforced policy might be ideal.

#### **4.5. Strengths and limitations**

The research study had a high response rate, with 94% of the eligible population taking part. This represents a large population coverage in the facilities. A limitation in this study was the comparison between genders, with the workplace being male dominated and so making the comparison between genders impossible. The volume of literature in relation to HPDs in an underground mine environment was limited. As there is a limitation in the literature available, our study can be used as a reference in the future regarding the perception of using HPDs in an underground mine.

### **5. CONCLUSIONS**

Workers exposed to high noise levels in a mining setting demonstrated a greater adherence to wearing HPDs depending on several factors. Personal discomfort is a factor in the adherence to wearing HPDs. Adherence to wearing HPDs was not affected by the years of employment or duration throughout the working day wearing HPDs. The results reflect those workers will wear HPDs if the organisation has a clear safety management policy for enforcement, provide appropriate and sufficient HPDs to all workers. However, HPDs should only be worn when all other noise reduction and control measures cannot reduce the exposure risk to workers. Additionally, health and safety management should encourage, regularly assess leadership, attitudes and behaviours among employees to ensure employees performing safe behaviours, i.e., wearing HPDs when required. For further study a longitudinal study should be considered so that behavioural change in wearing HPDs might be observed in the long run.

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