

1 Article

2 **Occupational noise induced hearing loss in the**  
3 **mining sector in South Africa: How are mineworkers**  
4 **trained - perspective from occupational health**  
5 **personnels**

6 **Nomfundo Moroe<sup>1\*</sup>**

7 <sup>1</sup> University of the Witwatersrand1; nomfundo.moroe@wits.ac.za

8 \* Correspondence: Nomfundo.moroe@wits.ac.za; Tel.: +27-11-717-4501

9

10 **Abstract:**

11 The aim of this study was to explore perspectives of occupation health personnels (OHPs) regarding  
12 education and training of mineworkers on occupational noise induced hearing loss (ONIHL) and  
13 its impact on mineworkers' hearing. Qualitative, in-depth telephonic and face-to-face interviews  
14 were conducted with 16 OHPs comprising representatives from the state, employer and labour as  
15 well as audiologists and occupational health hygienists. Purposive and snowball sampling were  
16 utilized to recruit participants. Data were analysed using inductive thematic analysis. Findings  
17 revealed that mineworkers have a superficial awareness and knowledge of the impact of noise on  
18 their hearing and health. Moreover, OHPs are not knowledgeable on how mineworkers are  
19 educated on ONIHL and its latent consequences. Furthermore, language, low levels of education  
20 and literacy as well as the financial constraints were factors that had a negative impact on raising  
21 awareness and training mineworkers. There is a need to prioritize health literacy among  
22 mineworkers. Additionally, audiologists need to play an active role in educating mineworkers  
23 about the effects of excessive exposure to noise. There is a need to take into account literacy levels  
24 and language barriers in planning training material for mineworkers.

25 **Keywords:** awareness, education, hearing loss, mineworkers, occupational health, health literacy,  
26 audiologists

27

28 **1. Introduction**

29 Occupational noise induced hearing loss (ONIHL) has received little, if any, attention especially  
30 in the period preceding 1994 in the South African mining industry. Historically, occupational health  
31 concerns associated with mining, particularly ONIHL was ignored by the mining sector, policy  
32 makers, and academic researchers[1]. Consequently, mineworkers were not aware of the latent effects  
33 of excessive exposure to hazardous noise and the resultant hearing loss thereof.

34 A literature search into ONIHL in the mining sector in South Africa prior to 1994 revealed only  
35 one study[2] which was conducted on White mineworkers, to the exclusion of Black workers who  
36 formed the majority of the mines' workforce. It was only in 1994, at the apartheid-democracy  
37 twilight that a study was conducted on Black mineworkers[3]. This study explored knowledge and  
38 attitudes of Black mineworkers regarding ONIHL and the use of hearing protection devices (HPDs).  
39 Findings revealed that mineworkers were firstly, not aware that noise was a health hazard. Secondly,  
40 their knowledge was based on personal experiences and observations, rather than formal educational  
41 input. Thirdly, mineworkers were self-motivated to protect themselves from acquiring a hearing loss  
42 and to learn more about the effects of noise. Lastly, mineworkers complained about discomfort,

43 feelings of insecurity due to inadequate communication and inability to hear when using HPDs.  
44 Findings of this study are consistent with Simon's[4] assertions that Black workers were not given  
45 instruction on occupational health and safety issues as they were seen as incapable to learn.

46 Two decades later in 2015, a study exploring the use of HPDs among mineworkers was  
47 conducted in mines in South Africa[5]. Findings revealed mineworkers still complain about comfort,  
48 design and work-related communication due to HPDs. However, in this particular study,  
49 participants were reportedly knowledgeable regarding noise exposure levels, ONIHL and  
50 appropriate use of HPDs.

51 In the same year, 2015, a descriptive survey was conducted to evaluate ONIHL awareness  
52 training programmes in six mines in South Africa[6]. Findings suggested, firstly, there is a lack of  
53 prioritization of commitment to awareness training by management. Secondly, a large majority of  
54 mines lacked a solid and consolidated theoretical basis for their awareness training programmes.  
55 Lastly, there were challenges with the language used during awareness training.

56 In 2018, a study conducted on the management of ONIHL in the mining sector revealed  
57 awareness training of mineworkers as one of the successes realized by the mining sector[7].

58 Despite these reported successes, the fact that there is a mismatch between findings in the studies  
59 by Ntlhakana, [5] and Edwards, [6] raises questions into how mineworkers are informed about the  
60 latent and subsequent sequel of ONIHL. Arguably, data for both these studies were obtained from  
61 different sites and contexts, therefore, differences in results should be expected. Nevertheless,  
62 education and awareness are part of hearing conservation programmes (HCP) which all South  
63 African mines were mandated to implement in 1996[8]. Therefore, it may be logical to expect  
64 similarities in how the programmes were implemented in the mines.

65 Currently, awareness on ONIHL may be overshadowed by the increased burden of disease,  
66 particularly HIV/AIDS and tuberculosis, the most prevalent diseases in the South African mining  
67 industry[9, 10]. Relying on anecdotal evidence and findings presented by Edwards et al [6], it appears  
68 that mineworkers are not well informed about the effects of ONIHL. Moreover, the mining industry's  
69 efforts in targeting education are not yet successful. Therefore, there is a need to conduct studies to  
70 ascertain how mineworkers are educated on ONIHL and its consequences. Therefore, the current  
71 study explored perspectives of occupation health personnels (OHPs) regarding educating  
72 mineworkers on ONIHL and its impact on their health. Obtaining perspectives and opinions of  
73 mineworkers, as individuals exposed to noise, regarding their training is preferred and ideal. Due to  
74 difficulties in gaining access into the mining sector for data collection purposes[11], it was not  
75 possible to obtain this information from mineworkers.

## 76 2. Materials and Methods

77 Methods followed in this study have already been described previously; however, the reference  
78 is not mentioned to ensure a blind review. This study is nested on a PhD study titled "Occupational  
79 Noise Induced Hearing Loss in South African Mines: From Policy Formulation to Implementation  
80 and Monitoring". This current study aims to explore perspectives of OHPs on awareness and training  
81 of mineworkers on ONIHL and its impact on their health.

82 This study sought to understand perspectives of OHPs on the awareness and training of  
83 mineworkers on ONIHL and impact on health. A qualitative design, which uses a naturalistic  
84 approach in seeking to understand a phenomena in context-specific settings, without the influence  
85 of the researcher, thereby eliminating the manipulation of and allowing the phenomena of interest to  
86 unfold naturally was employed in this study [12, 13].

87 Purposive snowball sampling was utilized to recruit possible participants identified from  
88 websites of companies affiliated with the South African mining industry. Participants were contacted  
89 via emails and telephonically. Furthermore, they were requested to identify and request other  
90 participants on behalf of the researcher to participate. Therefore, snowball sampling, as discussed by  
91 Penrod[14] was necessary in this study because of the challenges experienced by the researcher in  
92 identifying and recruiting participants. Ultimately, 16 participants were obtained and interviewed.  
93 Participants compromised six representatives from the Mine Health and Safety Council of South

94 Africa seven audiologists and two Ventilation and Occupational Health Engineers, and one  
95 occupational hygienist, herein referred to as OHPs. Participants were required to be involved in the  
96 management of ONIHL in the mining industry for 6 months and more.

97 Data were collected through in-depth face-to-face and telephonic interviews. The interview  
98 structure followed recommendations by Rubin[15] where the interviewer possesses a plan of inquiry  
99 as well as a set of questions. All the interviews were conducted in English and were audio recorded  
100 for analysis. Research questions focused on the OHPs perspectives on awareness and training of  
101 mineworkers on ONIHL and its effects.

102 Procedures contributing to this work comply with the ethical standards of national and  
103 institutional guidelines on human experimentation. Ethical approval was obtained from the  
104 University's Medical Ethics Committee (Protocol number M160264) and the work adhered to the  
105 Helsinki Declaration of 1975, as revised in 2008 [16]. Furthermore, ethical aspects such as  
106 confidentiality, right to withdraw from the study were discussed with the participants. Anonymity;  
107 however, could not be guaranteed as snowball sampling was utilized.

108 Reflexivity and bracketing were applied to guard against any bias from the researcher. A peer  
109 reviewer served as a mirror and assisted in reflecting on the researcher's responses to the interviews.  
110 Also, current authors made use of the "community of practice" as described by Rossman [17] to share  
111 the process and findings of the study with a group of colleagues familiar with ONIHL and policies  
112 governing noise management in the mines. Furthermore, after transcribing the interviews, the  
113 researcher conducted member or participant checks to "learn from the interviewee how well the  
114 researcher's interpretations reflect the interviewee's meaning" [18].

115 Inductive thematic analysis, an analytic process which allows for the coding of data without  
116 attempting to fit it into a pre-existing coding frame, or the researcher's analytic preconceptions, thus  
117 allowing the themes to emerge from the data themselves was used in this study [19]. Data were  
118 analysed using six steps namely: familiarization with the data, generate initial codes, search for  
119 themes, review themes, define themes, and write-up[19]. Representative verbatim quotations were  
120 used in the write up of the study to provide examples of the themes.

### 121 3. Results

122 The following themes were identified and discussed below: seeing is believing, not my  
123 department, blame it on the language and compensation payouts.

#### 124 3.1. Theme 1: Seeing is believing

125 Participants were asked to share their perspective on whether mineworker are aware of the  
126 impact of ONIHL and its latent consequences on their hearing. The majority indicated that the  
127 workers are superficially aware of the impact of noise.

128 P11 felt that, although the miners are aware of the impact, they only fully appreciate the impact  
129 when they develop a hearing loss.

130 "I think so. Yes. But I don't think the fact that it is permanent (hearing loss), cannot be cured. I don't think  
131 that people realize that. I think at the back of their minds they think when they go away from the mines, back  
132 home, their hearing will get better again. I think they have this perception that while I'm in the noise, it's  
133 damaged but once I go home and I'm not working in the mines anymore my hearing will improve. P11

134 P1 believes that since hearing is insidious and is an abstract concept to grasp, some workers do not  
135 actually understand the implications of acquiring a hearing loss.

136 But I think what we need to remember is that the ear is a very abstract thing for them (workers). When we tell  
137 people there is a hole in your eardrum, it's like what are you talking about! They don't see it. That's the  
138 problem. Our workers are people who want to see something. You know, when I break my arm and the bone is  
139 sticking out, I can see it you know. So next time, I'm gonna [going to] (sic) be careful doing that job because

140 my colleague was injured and I saw the blood. I think hearing loss, because it is an invisible thing to them, I  
141 think it is a difficult thing to comprehend.

142 3.2 Theme 2: Not my department!

143 Participants were asked to elaborate on how workers are educated on the impact of ONIHL on their  
144 hearing. Responses highlighted that participants are ,0knowledgeable on how workers are trained.  
145 It should be noted that these participants are occupational health personnels and they should either  
146 be involved in the education or be informed on whose role it is to inform workers regarding the  
147 effects of ONIHL.

148 "I don't know how it's done. It's in the law that the worker must be trained, how to clean and use his  
149 protection but it's also done at the Safety department. Also nothing to do with the Medical department (sic).  
150 So it's definitely in the law but I don't know which programmes or how many hours or you know, exactly  
151 how it's done".

152 P7stated that:

153 "I don't know. I'm not 100% sure. I'm sure that they get information on that. For example, at XXX mine  
154 there was a big... like a waiting area. And there is a tv that shows all these videos and information. I know  
155 there, they have something. But I'm not 100% sure. .

156 While P 1 admitted that:

157 "To be honest we haven't done a campaign solely on noise and I think this year, depending on funding we will  
158 look into such a campaign"

159 3.3 Theme 3: Barriers and facilitators to raising awareness

160 Two subthemes were identified with regard to barriers and facilitators to raising awareness. The  
161 first subthemes (blame it on the language) was on the part of the OHPs while the second subtheme  
162 (compensation pay-outs) was on the part of the mineworker. These barriers were also cited as  
163 facilitators, in that, if they are overcome, they can enable and positively contribute towards  
164 promoting awareness and education among the mineworkers.

165 3.3.1 Blame it on the language

166 Participants were asked to share possible barriers to teaching mineworkers about ONIHL and its  
167 effects. Language and levels of education were highlighted as the biggest barriers.

168 P 8 admitted that language differences contribute to the difficulty in teaching:

169 "Obviously, I know that I'm lacking in my communication with my patients. I always feel that it is important  
170 to have good communication with all my patients that I see. Most of them can't even speak English or  
171 Afrikaans. So that is a struggle for me. I really try my best P8.

172 Participant 5 shared a similar experience:

173 They do understand the basics because they have been getting screened for a very long time. But getting to the  
174 details... that is a struggle for me because I'm not able to communicate with them in a language that they  
175 understand P5"

176 Participant 14 mentioned the levels of education as barrier as well.

177 "It's difficult; you know your skills levels, your education levels generally in the mining industry is not that  
178 high for your average worker. Most of them do not have proper education and you know, so I think it's a very  
179 difficult thing"

180 3.3.2: *Compensation pay-outs*

181 Participants were asked, in their perspectives, why mineworkers still present with a high incidence  
182 of ONIHL if they are aware of ONIHL and its effects. Responses indicated that socio-economic  
183 factors may be at play.

184 "I definitely think that compensation plays a very big role. I definitely think that it plays a very big role  
185 because unfortunately we see a lot of people who pretend to have a hearing loss because they want  
186 compensation. It is something that in a very sad way motivates them not to look after their ears because they  
187 think they going to get money." P7

188 Participant 6 confirmed financial gain as a major contributor

189 "...You know because there are production bonuses in the industry. Sometimes people feel... people then  
190 sacrifice Health and Safety because they are chasing production bonuses".

191 While participant 2 also shared her concern about the observed practice

192 "...when we intervene, then the exposed individual says 'I can hear' because there are incentives for high  
193 production and you know so and so is strong. That same individual will go back to drilling because he knows  
194 that his team depends on him. So there are those dynamics".

195 P2 further elaborated:

196 "So then the discussion shifted to should there not be indicators of health and safety that are included in the  
197 bonus. So... you know, sort of be remunerated or rewarded for high production but also at the same time  
198 keeping or maintaining health and safety".

199 **4. Discussion**

200 Perceptions of OHPs indicated that mineworkers have limited and superficial knowledge  
201 regarding noise exposure and its effects on them. Mineworkers do not fully grasp that ONIHL, due  
202 to its latency and painless nature is irreversible and permanent and that once acquired, there are no  
203 guaranteed benefits from rehabilitation [[20-22]. These findings are consistent with studies reporting  
204 medical information presented at the time of diagnosis can be misunderstood or easily forgotten  
205 [23, 24]. This may be the case with the mineworkers. These findings have implications for how  
206 information is presented to the mineworkers. This becomes particularly important when we consider  
207 levels of education for most mineworkers in South Africa. Although, literacy levels have improved  
208 among mineworkers [28] in the past few years, especially with the advent of millennials in the mining  
209 sector. Nevertheless, to promote health literacy among mineworkers, literacy levels of mineworkers  
210 is important. For instance, Edwards [6] indicated that the material content used to train workers was  
211 the same as that used for managers and other levels of workers. These findings shed light on some of  
212 the reasons mineworkers have superficial knowledge on ONIHL and its impact.

213 Therefore, address literacy and language barriers, information must be matched to the  
214 worker's levels of understanding by utilizing a range of modalities such as verbal, visual and printed  
215 material to enhance learning and improve awareness while observing literacy, cultural, and linguistic  
216 relevance. In this way, even complex concepts can be understood if appropriate communication skills  
217 are [25]. It is known that physicians explanations and the level of patients' understanding  
218 significantly affect treatment adherence, treatment outcome, and patients' satisfaction [26]. The same  
219 argument applies to OHPs, if trainers explain concepts at the level of mineworker's understanding,

220 workers will have deep knowledge and understanding of the consequences of excessive exposure to  
221 noise in the workplace, and they will be more likely to adopt and practice change in behaviour in the  
222 workplace. Ultimately, this will improve and promote health literacy among mineworkers [27].  
223 Education and motivation are a priority in minimizing hearing loss in the mines as they create  
224 opportunities for both management and employees to discuss and agree on commitments,  
225 communication lines and cooperation [28]. If individuals understand the reasons and the benefits of  
226 a HCP, they are more likely to participate, especially if training addresses the specific needs of  
227 individuals exposed to excessive noise.

228 Findings also indicated that OHPs believe mineworkers are informed regarding ONIHL and its  
229 effects. However, OHPs were not aware or knowledge on how mineworkers were informed or  
230 trained on ONIHL. These findings raise questions on how and who is responsible for the training of  
231 the workers. Byrne [28] asserts that before implementing HCPs, mines should address administrative  
232 issues; where company regulations as well as individuals' responsibilities and roles are identified  
233 and enforced. From the responses above, it is not clear who is responsible for educating mineworkers  
234 on ONIHL. Interestingly, even audiologists who participated in this study did not seem involved in  
235 raising and training of mineworkers.

236 The scope of practice for audiologists include, among other responsibilities, includes  
237 prescription of and counselling for the use of hearing protection as well as education and training of  
238 employees[29]. Audiologists are responsible for educating and training mineworkers on the negative  
239 impact of ONIHL. However, in South Africa, evidence indicates that there are a few audiologists  
240 employed in the mining sector as mines prefer services of audiometrists who are considered more  
241 cost effective [30]. Edwards [6] commented that mines have a lack of qualified professionals, who  
242 possess knowledge and skills on how to teach adults to achieve health promotion and behaviour  
243 change. Therefore, these findings highlight the important role of audiologists in actively participating  
244 in educating and training mineworkers regarding the impact of ONIHL on their hearing and health.  
245

246 Audiologists are trained to provide programmes tailored to the needs of the workers; develop  
247 or recommend appropriate educational materials; instruct in-house staff in effective methods of  
248 motivating and educating workers; contribute to management education by preparing articles for  
249 publication or speaking before trade and management groups and maintain up-to-date knowledge  
250 of pertinent local, state, and federal regulations in order to provide management with accurate  
251 information concerning these matters[31]. There is therefore a need for audiologists to play an active  
252 role in providing direction on the material and strategies in teaching mineworkers and management  
253 on ONIHL and its effects on individuals exposed to excessive noise.

254 This study also brought to the fore issues of language in the training of mineworkers. Nelson  
255 Mandela, the late former president of South Africa accurately captures the importance of language  
256 when engaging with people. "If you talk to a man in a language he understands, that goes to his head.  
257 If you talk to him in his language that goes to his heart" [32]. This quote rings true in this context  
258 where language seems to be a barrier in achieving the desired results in the training of workers.  
259 Edward [6] also highlighted language as a barrier in a study conducted in the mines in South Africa.  
260 South Africa is a multilingual country with 12 official languages. Consequently, for instance, using  
261 English as a chosen mode of communication excludes workers who may not be efficient in the  
262 English. In the 2011 Census, results indicated that Zulu is the most spoken language however, not  
263 everyone is fluent in this language. Moreover, Africa is a developing continent and South Africa is  
264 viewed as the richest developing country in Africa due to its infrastructure, it has led to people from  
265 neighbouring countries migrating to South Africa to seek better job opportunities in the mining  
266 industry. This has resulted in a culturally and linguistically rich and diverse environment. OHPs  
267 therefore, need to take language and culture into account when planning worker-training initiatives  
268 within the mining sector.

269 Workers may be aware of ONIHL and its effects; nevertheless, socioeconomic difficulties may  
270 play a role in health practices of mineworkers. South Africa as a whole is faced with high levels of  
271 unemployment, high burden of disease as well as increased cost of living. Historically, mineworkers

were unskilled and uneducated and were refused skill training to improve their skills and their salaries [31]. Salaries for unskilled mineworkers are low, particularly when considering the high cost of living in South Africa. For instance, in 2003, the average salary for a mineworker in a gold mine was approximately R5000 at entry level, rising to R8000 with the inclusion of housing and food allowance. Overtime and bonuses improved the salaries to R11 000 a month [33]. In 2012, it was rumoured that "the salaries of chief executives in the mining sector have quadrupled over the past few years despite the global economic crisis and are 150 times higher than the pay of an average mineworker" [34]. To put this into perspective, South Africa has dominated the mining industry for about 120 years, reaching its peak in 1970, although in 2004 there was a slight decline in production, South Africa nevertheless remains the biggest producer of gold globally, maintaining its growth economically [35]. This is, however, not consistent with the income levels of those that work in the mines. Although, these findings are based on OHPs speculations, nonetheless, they highlight the plight faced by workers in meeting their financial obligations. It is sad that some miners may resort to exposing themselves to excessive noise for financial gain. However, it is also comforting that the mining industry is aware of this predicament, hence the attempt to balance high production with maintaining health and safety as alluded to by P2.

## 5. Conclusions

One of the most important components of an effective HCP is the education and motivation of workers and management [31], consequently, "no cause can succeed without first making education its ally" [36]. Furthermore, success of programmes rely on the involvement of all stakeholders to ensure that objectives and outcomes are identified and achievable [37]. Additionally, stakeholders are likely to support initiatives if they are involved in the decision-making process [38], as without their support, initiatives may be ignored, criticized, resisted or even sabotaged [39]. Mineworkers are primary stakeholders in the management of ONIHL; however, they seem excluded in the process. If the mining industry is committed in eliminating ONIHL, they should involve mineworkers in decision-making processes as to ensure active participation, empowerment, and support for the programme. Education and active participation of mineworkers will go a long way in achieving the desired results as far as eliminating ONIHL is concerned. Furthermore, audiologists also need to take an active role in educating and training mineworkers and other professionals on the impact on excessive noise in the workplace.

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