AN ASSESSMENT OF THE IMPLEMENTATION OF THE HEARING CONSERVATION PROGRAMME: A CASE STUDY OF FARM WORKERS IN VHEMBE DISTRICT, LIMPOPO PROVINCE IN SOUTH AFRICA.

By

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DECLARATION

I, RatshulumelaThinawanga Patricia hereby declare that the dissertation titled, “An assessment of the implementation of hearing conservation programme: A case study of farm workers in Vhembe District, Limpopo Province in South Africa” hereby submitted by me for the degree, Master of Public Health(MPH), has not been submitted previously for a degree at this university or any other institution; that it is of my own work in design and execution, and that all the reference material contained herein have been duly acknowledged by means of complete references.

Signature: _____Date_____

ABSTRACT

Hearing Conservation Programme (HCP) has been reported to be effective in protecting the hearing of South African workers who are exposed to occupational noise. In order to reduce Noise Induced Hearing Loss (NIHL) among these workers, a team work that includes an Occupational Audiologist in the proper implementation of hearing conservation programme is needed.

The aim of this study was to assess the implementation of hearing conservation programme amongst farm workers in Vhembe District, Limpopo Province in South Africa.A quantitative research approach using cross sectional survey design was used to assess the implementation of the programme among farm workers in Vhembe District, Limpopo Province in South Africa. A self administered questionnaire with both open and closed ended questions was administered to both males and female respondents aged between 19 and 50 years. A total population of 260 farm workers were systematically selected and a sample size of 76 respondents were randomly selected and participated in the study. Permission to conduct the study was obtained from the Ethics Committee of the University of Venda and the office in charge of royal macadamia. The data collected was analyzed using the Statistical package of Social Sciences (SPSS) version 23,0 software. A test-retest method was used to ensure reliability and findings of the study and formed the basis of recommendations.

The results of the study indicate that 82,9% of the workers who were exposed to noise for more than 14hours were not using hearing protection devices even though they were supplied. The training on the effects of noise on hearing was received by a quarter (25%) of the farm workers leaving out a large portion of 75% of workers not knowledgeable about the hearing conservation programme. A very small percentage of 3,9% indicated that they had a documented hearing loss against a large number of 96,1%. The findings show that only engineering noise controls are available and there were no provision of noise maps as part of monitoring hearing conservation programme.The farm workers need to be motivated to wear hearing protection devices in order to conserve their hearing. The management of the farm may organize an in-service training regarding the proper implementation of hearing conservation programme.Dermacation of noise zones would remind workers to put on their ear protectors before entering the noise area as part of monitoring the hearing conservation programme.
Keywords: Assessment, Hearing conservation programme, Implementation, Programme, Farm workers

DEDICATION

This research project is dedicated to my husband Phillemon and my three daughters Thendo, Thikho and Anza-Tshilidzi for being my pillar throughout the study. Thank you for all the support that you gave me day and night.

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LIST OF ABBREVIATION AND ACRONYMS

HCP	Hearing Conservation Program
HPD	Hearing Protective Devices
NIHL	Noise Induced Hearing Loss
OHSA	Occupational Health and Safety Association
TTS	Temporary Threshold Shift
PTS	Permanent Threshold Shift
WHO	World Health Organization

CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1. 1 Introduction

Poor implementation of a Hearing Conservation Programme (HCP) may lead to an occupational hearing loss which is a burden that many people bear unnecessarily. It affects many lives, causing frustration due to frequent missing words and sounds during communication, leading to embarrassment and social isolation thereby disturbing the quality and pleasure of life (Burkey, 2015). All over the world many governments are still struggling to implement the Hearing Conservation Programme even though they are still faced with the growing level of noise induced hearing loss in work places. In most developing countries like South Africa, HCP implementation is also a challenge with too much concentration in mining sectors and being neglected in most of the industries (Hoare, 2014). According to the National Rights Health Charter, everyone has the right to a healthy and safe environment (SAMA, 2016).

1.2 Background to the study

In seeking to bring about a solution to the problem of growing cases of Noise Induced Hearing Loss(NIHL) in workplaces, the South African Department of Labour Occupational Health and Safety (Act No 85 of 1993) as amended, has designed a hearing conservation programme. This Act states that no employer or self-employed person shall require or permit a person to enter any workplace under his or her control within which the person will be exposed to noise at or above 85 decibels(dB). It is also recommended that the employer should make sure that the employee be adequately and comprehensively informed and trained with regard to regulations, risks of noise exposure and the measures that are taken by the employer as far as protection is concerned.

Hearing conservation practices are known to be effective and useful globally through the noise survey of workplace. They consists of Monitoring, Audiometric testing, providing hearing protective devices, training and record keeping (OSHA, 2002). In other developed countries they also include noise control methods where they use acoustic materials in corridors and along the paths in working areas as a means to reduce noise without affecting noise generating machines in industries. However, most countries acknowledge the fact that it is not easy to implement a HCP in the environmental settings (Latos and Stankiewicz, 2015). In the United States the department of defense acknowledges the fact that better HCP practices are possible on areas like monitoring, identifying noise exposure, use of hearing protection devices, audiometric testing

and program evaluation. This would assist in the lowering of report cases presenting with symptoms of noise on hearing even though the best practices are not consistent (Theodoroff, Lewis, Folmer, Henry and Carlson, 2015).

Globally, the problems of poor implementation of HCP resulting in noise induced hearing loss (NIHL) is prevalent in both developing and industrialized countries. HCP has to be implemented in order to protect hearing for all workers who are working in noise areas (OHS Act, 2002-revised). However, this is still a challenge even in developed countries like United States of America (USA). Even though HCP is in place in USA, they do not have systems in place to protect farm workers from developing NIHL. This is because farms in USA are small, run by families and they do not have labour advocacy for workers concerning their hearing health (Mccullagh and Ronis, 2015).

While other nations seem to be alert to the need for HCP, there is still a great need for others to implement them. According to Marfoh (2011), a study conducted in Offinso Municipality, Ghana, revealed that out of 600 participants, 135 of them were diagnosed with a significant hearing impairment, with men found to be more affected than women. NIHL was identified as one of the hearing disorders among the corn mill and chain saw machines operators in that study. The findings indicated a need for hearing loss prevention and rehabilitation strategies (Marfoh, 2011).

The African continent is characterized by innumerable mining operations in its countries. As a result, exposure to loud noises seems to be inevitable. The need for hearing conservation programmes is even more apparent, especially considering the statistics of NIHL among mine workers. In Tanzania, out of 246 underground mine workers, 47% were identified with NIHL that increased with the total years of exposure to noise (Musiba, 2015). In Zimbabwe 27, 4% mine workers were identified with NIHL (Chadambuka, Mususa and Muteti, 2014).

In South Africa a study conducted by Mizan, braham, Sekobe, Kgalamono, Ndaba, Manganyi and Wilson, (2014) at 8 major producers of iron and steel companies revealed that hearing conservation practices are in place as far as baseline, periodic and exit audiograms are concerned. Even though a gap has been identified where employees were reported to be trained but still unable to fit their hearing protective devices properly. Employees were also unable to recall the period that they received their last training.

The study further revealed the gap which included the need to implement the standard operational procedures by medical professionals together with a quality assurance programme and to put an

evaluation tool in place in order to measure the effectiveness of the hearing conservation programme (Mizan et al., 2014). The problem of noise induced hearing loss has impacted negatively on the health of industrial workers, with little being done to protect them from noise exposure (Widen, 2013).

1.3 Problem statement of the study

The researcher is a Clinical Audiologist who is currently working in a hospital setting and has a concern about the growing number of workers coming for consultation complaining of occupational hearing loss, even though the Hearing Conservation Programme is already in place. She noted that the majority of the patients were from Levubu Area and the Royal Macadamia Farm is one of the big farms situated in Levubu just along the road to Louis Trichardt. In 2014, out of the estimated 13719 patients seen in six hospitals in Vhembe District, 8513 presented with a hearing loss and from these patients 118 presented with NIHL (Source: Vhembe District Statistics, 2014).

The issue, however, is that currently South African workers in factories, mines and industrial companies continue to be diagnosed with NIHL although the programme has been in place for more than ten years now (Basner, Babisch, Davis, Brink, Clark, Jansen and Stansfeld, 2014). This may suggest that there are other factors influencing the development of NIHL, instead of just the work environment leading to NIHL, or that the hearing conservation programme is not being adequately implemented in the country's work-places (Sliwinska-Kowalska and Pawelczyk, 2013). The researcher thus sought to find out more regarding the matter, the implementation of Hearing Conservation Programme in one of South Africa's production industry, farming.

1.4 Rationale of the study

Ntlhakana (2014), conducted another study exploring the knowledge, attitude and views of South African Mine Workers regarding NIHL and the use of Hearing Protection Devices (HPDs). It is important that hearing conservation as a prevention measure in working environment be conducted. On the other hand, Strauss, Swanepoel, Becker, Eloff and Hall, (2012) also conducted a study and focused on the rate of NIHL. Although much of the research to date has focused on

the mining sector, there is no known study that has concentrated on the implementation of hearing conservation programme among farm workers in the agricultural sector.

1.5 Significance of the study

The findings of this study may assist the Royal Macadamia management to improve their hearing conservation programme. Secondly workers may be aware of the importance of wearing their HPDs every time they enter a noise zone in order to conserve their hearing. However, in a situation where they do not have a hearing conservation in place, the assessment may assist them to establish one. The results may also assist the policy makers in reviewing Occupational Health and Safety (OHS) policies. The findings may also be useful in the development and implementation of national and institutional guidelines regarding the use of hearing protection equipment and strategies to avoid induced hearing loss. The results may assist in the evaluation of the current practices of hearing conservation, hence promoting the health of employees and reducing compensation claims on the part of the employer.

1.6 Purpose of the study

The purpose of the study was to assess the implementation of hearing conservation programme amongst farm workers in Vhembe District, Limpopo Province in South Africa.

1.7 Objectives

Specifically, the study sought to:

- Assess the use of hearing protection devices by employees;
- Assess the training received and knowledge of employees with regards to the implementation of hearing conservation programme;
- Assess the availability of the audiological information with regard to the implementation of the hearing conservation programme;
- Assess the availability of systems to monitor and evaluate the hearing conservation programme;

1.8 Definitions of concepts

1.8.1 Assessment is the process of putting together information from different sources and discuss it in order to develop a deep understanding of what people know (Allen, 2004). For the purpose of this study, assessment was the process of finding out information about the practices of hearing conservation programme.

1.8.2 Hearing Conservation programme is a programme that provides information about the auditory system, hazards sound sources and methods of protecting a person from acquiring Noise Induced Hearing Loss (Dell, 2012). In this study hearing conservation was a programme established when employees are exposed to noise exceeding the Action levels which include noise surveys, audiometric testing, hearing protectors, training, and record keeping requirements (OSHA, 2002).

1.8.3 Farm workers are people who work in a land and buildings where people keep animals and grow crops (Oxford Dictionary, 2011). Farm workers in this study were those workers who were working in a factory where they processed and packaged nuts.

1.8.4 Implementation is the process of putting a plan or a thought into something effective in order to achieve something (Pahta and Jucker, 2011). According to this study implementation was the ability of both employer and farm workers to follow the hearing conservation protocols in order to protect their hearing.

1.8.5 A programme is plan of something that is done in order to achieve a specific result (Merriam-Webster.com). In this study a programme was a plan that was used in order to protect the hearing of farm workers.

1.9 Arrangements of chapters

Chapter 1: Introduction and background to the study.
Chapter 2: Literature review.
Chapter 3: Research methodology.
Chapter 4: Presentation of the study.
Chapter5: Interpretation and discussion.
Chapter 6: Summary, conclusion, recommendations and limitations of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to analyze critically and review different studies conducted by different schools of thought concerning the assessment of the implementation of Hearing Conservation Programme. There are many issues that contribute to the poor implementation of a Hearing Conservation Programme. This literature review will give an overview of hearing conservation, Hearing Conservation Programme in South Africa, the practice of a hearing conservation programme, the burden of NIHL and its consequences.

2.2 Hearing Conservation Programme: An Overview

Since the mid-1930s, the dangers of noise on the auditory system within occupational settings have been recognized among professionals. This recognition has led to regulations and laws, such as the Walsh Healey Act and the Hearing Conservation Amendment to reduce the number

of American workers that would suffer from NIHL (Royster, Berger and Royster, 2003).These laws have required the implementation of hearing conservation programmes .Hearing conservation programme is a method designed to protect workers who are working in a noted occupational noise area in order to protect them from developing permanent hearing loss as they would be working in such an area for a long period (Schiopu and Barda, 2013).

HCPs educate individuals about the risks associated with noise and are effective in prevention of NIHL among all age groups. An effective hearing conservation programme implemented by employers may prevent hearing loss, improve general feeling of well-being and employee's working attitude thereby increasing quality of production and reducing incidences of stress-related disease (Basner et al., 2014).

Hearing conservation include evaluation and registering the exposure to noise which are basically the measuring, recording and interpretation of the results of noise levels as the first step using the sound level meter. This will make the transition from the initial assessment to the monitoring process. Training and motivating employees is also part of the hearing conservation programme where workers form part of the multidisciplinary team (Schiopu and Barda, 2013). The main elements of a hearing conservation programme include hearing protection, Audiometric testing, monitoring of hearing conservation program, training and record keeping (Basner et al., 2014).

2.3 Implementation of Hearing conservation programme internationally

The numerous laws and regulations that are enacted for the protection of American adult workers from work-related noise hazards include: The Walsh Healey Noise standard and the Occupational Safety and Health Administration (OSHA) 1983 Hearing Conservation Amendment. The Hearing Conservation Amendment requires the use of permissible exposure level (PEL) or the maximum noise exposure of 90 dBA during an eight-hour workday (Walsh Healey standard) and an action level of 85 dBA during an eight-hour workday and the implementation of hearing conservation programmes and the use of hearing protective devices in the workplace (Rogers, Meyer, Summey, Scheessele, Atwell, Ostendorf and Lukes, 2009).

Basner et al., (2014) require that Occupational HCPs include noise measurement and monitoring, audiometric testing, use of hearing protection devices, employee education and training, record keeping, and programme evaluation for effectiveness (Berger, Voix, Kieper and Le Cocq, 2011). These laws and regulations were enacted to protect employees from hazardous noise exposure in industries that have noise, such as agriculture, mining, manufacturing, and the military.

During the Art of Hearing Conservation conference held in St Petersburg Florida in USA, papers were presented on hearing conservation through education, prevention and identifying mechanisms of hearing loss were given attention. Some researchers believe that occupational hearing screening is an important part for hearing prevention programme (Murphy and Griest, 2014). However, there are variations in different countries concerning the allowed levels of exposures to noise and the noise exposure levels without hearing protections. However, most developed countries recommend the implementation of a hearing conservation programme.

The Acoustical Society of America recommends that the audiometric testing component of hearing conservation programmes be administered yearly wherever possible, and at no more than two-yearly intervals elsewhere so that established criterion ranges remain equitable (Basner et al., 2014). It is also recommended that each successive year's audiograms be compared to those preceding it, rather than to an initial baseline measure, to avoid placing undue precedence on the accuracy of the first audiogram (Basner et al., 2014). As such, this approach requires accurate and reliable assessment to identify the beginnings of hearing loss over a relatively short timeframe. However, this practice could lead to a 'creeping' hearing loss that is not seen between one year and the next due to a gradual onset over several years.

In Argentina, the law 19.587 of 1972 determines the basic requirements with respect to safety conditions in the work place. Its current standard establishes a Permissible Exposure Level (PEL) of 85dBA with a q of 3dB and a maximum exposure of 124dB with no exposure without hearing protection at about 140dBC. When their workers are exposed to levels that are equal or greater than the limits, a complete hearing conservation programme is required (Murphy and Griest, 2014).

In Brazil, the law 3214 recommends the PEL of 85 dBA as well with the q of 5dB and no individuals without hearing protection are allowed at any noise above 115dBA. They also indicate that noise control measures should be implemented when exposure exceeds 80dBA for eight-hours. Other countries like Canada have also issued legislation for occupational noise exposure but because they have about 13 provinces, they permit each province to set its own limits which causes some variations among them even though their federal regulation indicate the PEL of 87dBA with a q of 3dB as well as the action level of 84dBA (Murphy and Griest, 2014).

The New Zealand national standard for continuous noise exposure is an LAeq,8h of 85dB(A) with an exchange rate of 3dB, while the maximum peak level permitted is (LC, peak) of 140dB(C).

These standards are based upon statistical calculations of risk and do not guarantee the protection of an individual. These legal limits are consistent with those used in most jurisdictions worldwide however New Zealand lacks some of the measures that some other governments have, such a system of action levels or specific controls on impact noise. Beyond the noise exposure limits, New Zealand law specifies that employers must identify, eliminate or isolate noise hazards wherever practicable, and provide hearing protection devices until this is achieved. The issue of 'practicability' potentially allows employers to rely on the inferior option of hearing protection alone as the basis for their noise-induced hearing loss control efforts (Sayapathi, Su and Koh, 2014).

While the evidence suggests that conservation programmes can be effective at identifying, monitoring and lessening the severity of noise-induced hearing loss, it appears that they cannot be considered a total and perfect solution. There is a difference between the plan of a hearing conservation programme and what is actually achieved in the field. In the review, Lipscomb 2005, provides an economic perspective on the implementation of hearing conservation programmes, stating that there are several barriers to effective hearing conservation programme implementation, particularly a reluctance to follow the full course of a programme including pre- and post-employment testing and regular sound measurement data.

2.4 Hearing conservation programme in South Africa

South Africa has adopted the HCP done by developing countries like United States of America and Canada through the international standards and in 1996 the mine health and safety Act (MHSA) was implemented which is currently utilized to protect the health and safety of mine workers (Ntlhakana, 2014).

In South Africa, the amended Occupational Health and Safety Act (No. 85 of 1993)as amended, through the Department of Labour, supports the aspect of hearing conservation by stating that everyone has the right to an environment that is not harmful to his/her health and well-being. It has become a powerful health promotion tool to both the employer and the employee in an effort to protect the health of workers at their work-places. Hoare (2014), revealed that the legal frame of South Africa emphasizes that hearing conservation programmes are mandatory, hence it was found to be just associated with negligence in most of the industries.

There are two important standard setting agencies on the development of laws requirements in South Africa as far as noise is concerned which are the ISO and the South African National Standards (SANS). These two agencies indicate the limit of noise exposure of eight-hour per day, four hours per week and an equivalent continuous level limit of 85dB(A). In the same note,

South Africa, is still compensating workers who acquire NIHL due to too much exposure to loud noise in their working environments as long as it is a 10% or more increase on the percentage loss of hearing (PLH) compared to the initial test at certain frequencies (Mizan et al., 2014).

The study further revealed that South Africa is the 21st largest Crude Steel producing in the whole world. Iron and steel manufacturing is one of the noisiest industries and NIHL is common. A study conducted in eight primary Iron and Steel companies in South Africa, shows that six out of eight companies have a policy on hearing conservation programme but they have difficulties in following it. Area measurements on noise exposure indicate that 78% of measurements in the iron and steel industry departments exceeds 85dBA limit.

2.5 The practice of Hearing Conservation Programmes

According to Basner et al., (2014), the practice of HCP should cover the following areas which will be discussed below:

The use of hearing protection devices, audiometric test, monitoring of HCP, training and record keeping.

2.5.1 The use of hearing protective devices

The use of hearing protective devises (HPD) has been implemented in South Africa according to the international standards from developed countries like Canada, United States of America and Australia (Nthlakana, 2014). It would seem that for a hearing conservation programme to be an effective prevention method, the focus needs to shift from the individual to the organization, and from personal exposure protection to general exposure prevention. The individual certainly has a large role to play in their own hearing safety, however they cannot be expected to shoulder the full burden of a problem that goes well beyond the control of any one worker (OSHA, 2002).

It is however noted that hearing protectors are very frequently not worn for the entire duration of exposure (Smith, Monaco and Lusk, 2014). The reasons for this can be based upon the perception of discomfort, interference with work tasks or a reduced ability to communicate or attend to warning sounds (Melamed, Rabinowitz, Feiner, Weisberg and Ribak,1996). Furthermore, it is suggested that the use of such protection is a matter of awareness, attitude and

experience, and that some individuals may simply choose to take a risk over wearing protection, regardless of their knowledge of the consequences (Lusk and Kelemen, 1993).

Noise- induced hearing loss is a largely invisible disorder without any obvious immediate indicators that appears gradually according to varied time course. Because of this it is suggested that workers are generally not motivated to do anything independently regarding noise at work (Turcot, Girard, Courteau, Baril and Larocque, 2015).

Hearing protection equipment are individualized depending on the person size of the auditory parts. Employees can choose any one that gives maximum comfort from the variety of them. There are different kinds of ear protectors ranging from earplugs, helmets, headsets etc. The selection criteria depend on the comfort as it has already been indicated by checking the adjustment of headset and ear plugs which is done specially to adapt each employee. In order to assess the level of protection, an audiometric test is usually carried out with the aim of verifying the use and efficiency of appropriate equipment (Schiopu and Bardac, 2013).

A study conducted by Michael, McTague, Galusha, Dixon-Ernst, Kirche, Slade, Cullen & Rabinowitz, (2013)**,** revealed that despite the best efforts of industrial hearing conservationists, occupational hearing loss remains prevalent worldwide where-in most industries, noise control efforts reduce the overall levels, but personal hearing protection is still required to lower the exposure to a safe level. A hearing protective device is a personal safety product that is used to essentially block and thus reduce the harmful effects of an auditory sound. Using hearing protectors are typically regarded as a last resort approach when other methods have been tried and found to be either not practical or economical (Berger et al., 2011).

Attenuation is the reduction or the decreasing of noise level as a result of using HPDs. The employer needs to evaluate the hearing protective device attenuation for a specific noise environment where the hearing protective device will be used. The effectiveness of HPDs must be re-evaluated whenever noise exposure increases to an extent that they no longer provide attenuation. The employer has a responsibility to provide effective HPDs (Basner et al., 2014).

A critical issue in the use of hearing protective devices is how the employee perceives the importance of the device and thus the employee uses the device consistently and properly. Selecting the correct hearing protector and responding to the needs of each employee is very important and therefore a coordinated effort between management and the employees is essential to ensure maximum noise protection (Sherman and Azulay, 2014).

The ability to work with employees involves education, motivation, supervision, enforcement, and attention to detail, ergonomics, and a hands-on attitude toward hearing protection. Employers should try to develop a positive work-place attitude toward the proper use of these devices and consideration should not only be given to the importance of using protectors through open communication channels, but also to the user's comfort, physical differences, cost, durability, style, and working conditions (Oliveira, 2013).

A study conducted by Berger et al., (2011) indicates that if hearing protective device are worn properly and consistently they may provide an effective protection against harmful noise to employees. The same study further reports that the above considerations were noted to be likely essential in order to minimize the company's overall cost of protecting the employee. It should be noted that no HPD can be effective if it is not worn by the employee or used correctly. There are some basic rules for safety professionals to bear in mind when selecting the best HPD for their situation.

2.5.2 Audiometric Testing

Hearing ability can be evaluated by a number of behavioral tests including testing of hearing thresholds at sounds of different frequencies. The hearing thresholds may be graphically displayed in an audiogram, which charts the threshold at each hearing frequency. Noise-induced hearing loss begins with an elevation in hearing threshold around the 3-6 kHz region of the audible spectrum leading to a ‘notch’ in the audiogram which spreads across the other frequencies of human hearing if sound exposure is maintained (McCreery Kaminski, Beauchaine, Lenzen, Simms and Gorga, 2015).

The audiometric testing programme follow up should indicate whether the employer’s hearing conservation programme is preventing hearing loss. Audiometric testing monitors an employee’s hearing over time and it provides an opportunity for employers to educate employees about their hearing and the need to protect it (Donogue, Frisch, Dixon-Ernst, Chesson, and Cullen, 2016). In alignment with the OSHA hearing conservation requirements, audiometric testing must be provided for every employee that is exposed to a noise level above a TWA of 85 dBA (Oliveira, 2013).

Hearing impairment is an increase in the threshold of hearing when assessed by audiometric test, while typically people may not be aware of the problem in the early stages but as the problem intensifies testing should be done (Masterson, Tak, Themann, Wall, Groenewold, Deddens and Calvert, 2013).

A study by Hoare (2014), in South Africa revealed that companies had an information and training programme conducted by Health and Safety Officers or South Africa Quality Assurance (SAQA) accredited trainers. In the same research all eight companies conducted baseline, periodical and exit audiograms. Five out of eight companies were complying with frequency of periodic audiometric testing but three companies did not comply. As far as periodic audiograms are concerned, the highest compliance was 48%. An average incident of NIHL of 0, 6 per 1000/year and a maximum of 8.3 per 1000/year has been obtained. It can be concluded that audiometric testing is a prerequisite in the implementation of a hearing conservation programme.

A baseline audiogram must be performed within six months of the employee's first exposure to harmful noise, and then the employee must be retested annually (Occupational Health and Safety Act, SA) as amended. It is indicated that licensed or certified audiologist, otolaryngologist, or other physician must be responsible for the programme. Both professionals and trained technicians may conduct audiometric testing. The professional in charge of the programme does not have to be present when a qualified technician conducts tests. The professional's responsibilities include overseeing the programme and the work of the technicians, reviewing problem audiograms, and determining whether referral is necessary (Meinke, Norris, Flynn and Clavier, 2017).

2.5.3 Monitoring of the Hearing Conservation Programme

Continuous monitoring of personal noise exposure is a new approach to industrial hearing conservation and it is a straight forward and simple solution to an often vague and difficult problem, based on a classic tenet of industrial hygiene, "If you prevent the exposure, you prevent the disease" (McTague, Galusha, Dixon-Ernst, Kirsche, Slade, Cullen and Rabinowitz, 2013).
The elegance of continuous monitoring lies in the simplicity of the methodology. First, we must realize that typical occupational noise-induced hearing loss (NIHL) does not occur after a single overexposure. Instead, occupational NIHL occurs after months and years of daily or frequent overexposures (McTague et al., 2013). Continuous monitoring provides safety personnel with full-shift employee exposure data on a daily basis. If an overexposure occurs, the safety representative must intervene appropriately**.** McTague et al., (2013) further indicated that the hearing conservation programme requires employers to monitor noise exposure levels in a way that accurately identifies employees exposed to noise at or above 85 decibels (dB) averaged over eight working hours, or an eight-hour time-weighted average (TWA).

On the other hand, Hoare, 2014 indicates that employers need to monitor all employees whose noise exposure is equivalent to or greater than a noise exposure received in eight hours where

the noise level is constantly 85 dB. The exposure measurement must include all continuous, intermittent, and impulsive noise within an 80 dB to 130 dB range and must be taken during a typical work situation. This requirement is performance-oriented because it allows employers to choose the monitoring method that best suits each individual situation.

As far as Basner et al., (2014) is concerned, employers were advised to repeat monitoring. The testing process should also be initiated immediately when there is a change in production or when a new equipments is purchased in order to ensure that noise exposure measurements are accurate. These changes may mean that more employees need to be included in the programme and it is also possible that their hearing protectors may no longer provide adequate protection.

Employees were entitled to observe monitoring procedures and receive notification of the results of exposure monitoring. The method used to notify employees was left to the employer's discretion Basner et al., (2014). Employers must carefully check or calibrate instruments used for monitoring employee exposures to ensure that the measurements are accurate. Calibration procedures are unique to specific instruments. Employers should follow the manufacturer's instructions to determine when and how extensively to calibrate the instrument (OSHA, 2002).

The employer must establish and maintain an audiometric testing programme. The important elements of the programme include baseline audiograms, annual audiograms, training, and follow up procedures. Employers must make audiometric testing available at no cost to all employees who are exposed to an action level of 85 dB or above, measured as an eight-hour TWA (OSHA, 2002).

2.5.4 Training

Employee training is very important in order to prevent negative attitude among employees based on the sensory information and risk control. It starts from informing employee's daily exposure, their involvement in the programme and training on how to use hearing protection equipment. It is also very important that the manager also demonstrate a personal example in wearing hearing protection equipment and participate in the training sessions. Manager's participation is a powerful tool to encourage employees in the use of personal protective clothing. Motivating employees constantly to participate in the programme is not easy and it needs lots of supervision as hearing loss occurs slowly over a period of time. The use of posters in demarcated areas also increases the adherence to the programme (Schiopu and Bardac, 2013).

According to a study conducted by Reese (2015) the employer needs to set a training programme for all workers who are exposed to noise. The training needs to be repeated once a year for each

employee according to the hearing conservation programme. Information given should always be updated with changes in protective equipment and work processes. The employer should inform the workers about the following:

- The effects of noise in hearing.,
- The purpose of hearing protectors, their advantages, disadvantages, their attenuation, selection, fitting, use and care., and
- The purpose of audiometric testing and an explanation of the test procedures (OSHA, 2002).

2.5.5 Record keeping

The main aim of OSHA record-keeping regulations is to help employers to be aware and make corrections in workplace hazards by tracking records of work related injuries and illnesses together with their causes. It is important that the employer keep all the records of all employees' exposure measurements. The record kept should include names and job classification of the employee, date of audiogram testing, examiner's name, date of last acoustic calibration of the audiometer and the employee's most recent noise exposure assessment. The employer must also keep a record of the background sound pressure level measurements in the audiometric test rooms. All records should be available upon request by employees, former employees, employee's representatives, and OSHA (OSHA, 2002).

Employers must keep noise exposure measurement records for two years and maintain records of audiometric test results for the duration of the affected employee's employment. OSHA (2002), further indicates that the implementation progress of hearing conservation relies on the record keeping of an institution. Record retention requirements are two years for noise exposure measurements, five years after the workers' employment period for audiometric tests, and five years for background sound pressure levels and audiometer calibration in audiometric test rooms.

2.5.6 Employers Responsibilities

Duties of employers in relation to noise hazard management according to OSHA, 2002):

- **Identification of noise hazards.** With the identification of noise hazards every employer is advised to ensure that there are effective methods to follow like identifying existing noise

hazards around employees at work; regularly assessing each noise hazard identified, and determining whether it is a significant noise hazard.

- **Significant noise hazards to employees to be eliminated if practicable**. Where there is a significant noise hazard to employees at work, the employer shall take all practicable steps to eliminate it.

- **Significant noise hazards to employees to be isolated where elimination is impracticable.** The employer may utilize all the possible steps in order to isolate the noted noise hazard even when all possible steps were taken but still the noise hazard has not been eliminated.

- **Significant noise hazards to employees to be minimized, and employees to be protected, where elimination and isolation is impracticable.** When everything has been done and still the noise hazard has not been eliminated, the employer may take the following steps (OSHA, 2002).

The steps are:

- To take all practicable steps to minimize the likelihood that the noise hazard will be a cause or source of harm to the employees.,

- To provide, make accessible to, and ensure the use by the employees of suitable clothing and equipment to protect them from any harm that may be caused by or may arise out of the noise hazard.,

- To monitor the employees' exposure to the noise hazard; and To take all practicable steps to obtain the employees' consent to the monitoring of their health in relation to the noise hazard., and

- With their informed consent, to monitor the employees' health in relation to exposure to the noise hazard (OSHA. 2002).

2.6 Noise Induced Hearing Loss (NIHL)

Noise induced hearing loss is a disorder that develops from exposure to continuous or intermittent noise over a certain period of time (Nair, 2014). Briefly, NIHL is the deafness that occurs when the ears are exposed to sounds in excess of what they can handle. But the question is what is sound and when does it become noise, or is there a distinct line between the two. From a physical stand point sound is composed of pressure waves passing through a medium and can vary in

amplitude, frequency and complexity. These three properties of the sound waveform translate to the perceptual sound characteristics of loudness, pitch and timbre respectively. On the other hand, 'noise' is defined as unwanted sound, sound that doesn't carry useful information and is generally considered undesirable or unpleasant (Kryter, 2013).

However, in terms of the physics of sound waves and energy there is no such distinction; both sound and noise are analogous (Agrawal, Niparko and Dobie, 2010). It is the physicist's definition of noise that is relevant to NIHL, as any sound can contribute to the disorder, regardless of its source or whether it is perceived as desirable or not. In terms of hearing loss, mechanical noise, music and big noisy machinery put a person at risk. The intensity, duration and cumulative exposure to a sound determine its pathological impact upon the ear. While sounds from certain sources tend to be longer and more intense than others, if any sound/noise is intense enough or long enough it can cause damage to the ears, resulting in a loss of hearing ability (Crandell, Mills and Gauthier, 2004).

Crandel et al. (2004) further report that the psychological distinction between noise and sound must be taken into account when considering noise-induced hearing loss. Despite the fact that the two relate to the same physical phenomenon and generally affect the ear in the same way, the difference in attitude that people create between noise and sound can influence their hearing safety and noise-avoidance behaviours. For example, studies have shown that people consider loud music to be 'good' sound, where more volume adds to the enjoyment (Almec, 2015). This is in contrast with industrial noise, which is generally seen as a 'bad' sound, where a higher volume is undesirable (Crandell et al., 2004).

Hearing, on the other end, is the perceptual response by the brain to sound waves that are received by the ears. The ear consists of three main divisions, namely, the external, middle, and the inner ear. The external ear serves to channel sound waves into the internal parts of the ear, and also provides assistance to spatial localization of sounds due to its shape. The collected waves travel along the ear canal through to the tympanic membrane causing it to vibrate. The middle ear is composed of structures that transfer the vibration of the eardrum into fluid movement in the adjacent sensory organ in the inner ear called the cochlea. Within the cochlea there is a network of fine sensory hair cells that are moved accordingly and it is this motion that causes the hair cells to create impulses in the auditory or hearing nerve. This translates the incoming pressure changes into neural signals, which are then sent via brainstem auditory centers to the primary auditory centers in the cortex of the brain. It is the hair cells that are affected by loud

sound exposure leading to NIHL (Kirchner, Evenson, Dobie, Rabinowitz, Crawford, Kopke and Hodson, 2012).

NIHL is characterized by a sensorineural component, because it primarily affects the cochlear hair cells found in the inner ear. NIHL usually affects both ears because most noise exposures are from both sides. It presents with a notch at high frequencies of 3000, 4000 or 6000 Hz. This type of hearing loss usually increases rapidly in the first 10 to 15 years of exposure (Kirchner et al., 2012).

NIHL is a permanent hearing loss which cannot be reversed. Management of this type of the hearing loss includes the use of hearing aids in order to assist the employee to hear speech and other sounds well. It is one of the most prevalent occupational condition that occurs in different industrial working conditions. However, it is preventable through hearing conservation programme which include engineering controls, personal protective equipment and administration controls (Kirchner et al., 2012). Collins, (2014) postulated that millions of workers in the world are exposed to noise at their working place. Exposure to noise is the second most important cause of hearing loss after the aging process.

2.7 The burden of NIHL

It is recognized that noise, which is any unwanted or undesirable sound, has been a problem in the work place since the Industrial Revolution (Michael et al., 2013). The National Institute for Occupational Safety and Health (NIOSH) indicates that worldwide, 10% of disabling hearing loss in adults is caused by occupational noise range from 7% to 21% in various sub-regions. The effects of NIHL is larger in males than in females. This maybe because historically men are more employed in industrial sectors than their female counterparts. NIOSH further indicates that in countries like USA, for the 22 million workers who are exposed to noise in their working areas, 242 million dollars are expected to be utilized in worker's compensation yearly.

The European Agency on Safety and Health at work (2005) reported that noise exposure is deemed to be a continuing risk within European countries. They further indicate that data collected during the period 1990 to 2000 showed that over a quarter of the European workforce, (29%) was exposed to high level noise. Approximately 20% of workers were exposed half or more of their working time to noise loud enough that they had to raise their voice in order to talk to other people.

Around 10% of the workers were exposed permanently to high level of noise. The report again showed that those countries that were in the survey reported an increase percentage of workers exposed to noise in the workplace over that period even though there was a 10% decline in the percentage of the noise exposure in the workforce in Germany between 1992 and 1999 (European Agency on Safety and Health at work,2005). According to the European Union Occupational Diseases Statistics, in 2000, about 7% of European workers believe that their work affects their health in form of hearing disorders. Overall workers have been reporting more hearing problems due to their work since 1995 (Russel, Maitre and Watson, 2016).

According to Paoli and Merllie (2001)**,** the European Survey on Working Conditions indicate that the proportion of workers experiencing loud noise in the workplace has increased and workers in all occupations showed more hearing problems in 2000 (7%) than in 1995 (6%), except among professionals, clerks, skilled agriculture workers and armed forces, which reported a decrease. The number of recognized cases of occupational deafness in Germany has stabilized since 1995 but the severity of the hearing loss is decreasing. In 1999, 4% of the workers reported that they have hearing problems and it is highest among older workers (about 7% of the workers above 45 years of age reported hearing problems). The highest incidence of noise-induced hearing loss was found among metalworkers, mechanics and construction workers.

A study conducted by Laird (2011), showed that the number of notifications for noise-related hearing loss in Denmark has steadily decreased since 1993, although the report that the large fall in the period up to 2000 cannot directly be related to noise reducing efforts, because the new restrictions of the notifications had been introduced during that time and that would have reduced the number of notifications. Noise exposure rates were regarded as a significant problem and were higher for workers in the manufacturing, construction and the agricultural sectors.

Palmer, Griffin, Syddall, Davis, Pannett and Coggon, (2002) revealed that the self-reported information indicated that an estimated prevalence of noise-induced hearing loss in the UK varied from 509 000, to 81 000. Work-related Illness survey conducted by the Health and Safety Executive in 2003-2004 reported about 170,000 people affected by noise between the age of 35 and 64 years. The same study further reported that about 266,000 men and 84,000 women in the same age had have persistent tinnitus that can be attributed to noise.

According to the UK Health and Safety Executive (HSE) over two million workers were regularly exposed to loud noise at work and about 1.7 million workers were exposed to noise that was

above the levels that were considered to be safe. In 2001, approximately a third of men and 11% of women had worked in a noisy job for a year or longer, with 16% of men and 3% of women reporting more than 10 years of such exposure. Six (6%) of men and 3% of women reported that work tasks left them with ringing in their ears or a temporary feeling of deafness at least every week. 3% of men and 2% of women said this sensation was daily. Despite the apparent decline in claims, hearing loss caused by work-related noise exposure to noise at work continues to be a significant occupational problem in the UK (Stucken and Hong, 2014).

In Australia in 2001/2002, there were 4510 compensation claims for noise-induced deafness with an average cost of $6711 per claim, representing approximately $30 million of noise-related compensation over the same period. However, it is estimated that compensation costs may be only 10% or less of the total costs of noise in Australia (NOHSAC, 2004). Up to one million Australian workers (12% of the workforce) were expected to be exposed to hazardous noise (Williams, 2013).

It is estimated that currently around a quarter of the New Zealand workforce of 1.47 million workers are affected to some degree by harmful noise at work (Mazlana, and Yahyab, 2015).

The 2003 ACC Annual Report states that despite knowledge of effective controls and guidelines, the prevalence of noise-induced hearing loss shows no sign of decrease. In the 2004-2005 year the rehabilitation costs directly related to noise-induced hearing loss totaled almost 43 million dollars (Thorne, Ameratunga, Stewart, Reid, Williams, Purdy and Wallaart, (2008). In Nepal, a study conducted by Robinson, Whittaker, Acharya, Singh and Smith, (2014) in a wood working industry indicated that 31% carpenters and 44% of sawyers met the criteria of NIHL with 7 to 17% workers meeting WHO criteria for hearing loss respectively.

According to a study conducted by Chadambuka, Mususa and Muteti (2014), in Zimbabwe, out of 168 underground miners, 27.4% were identified to have NIHL with 42% presenting with mild NIHL, and 28.8% with moderate to severe NIHL. The highest NIHL prevalence of about 60% was noted in workers of 50 years and above, 45.5% in 40 to 49 years of age, 20% in 30 to 39 years of age and 5.3% in 20 to 29 years of age. This statistic demonstrates that NIHL affects both young and old and thus, if not tackled successfully and effectively, may significantly affect productivity of the workers in a long term. NIHL in mine workers was high at 85% due to poor use of hearing protective devices. The same statistic was one strong reason why implementation of hearing conservation programs should be investigated among high risk workers such as these.

In Tanzania, a research conducted from about 246 mine workers in a gold mine company, the prevalence of NIHL was found to be 47%, and the proportion of a hearing loss increased with a total years of exposure to noise (Musiba, 2015). In the same study it was noted that those who were working underground were more affected (71%) than those in open hole (28%). The results of this study were utilized to motivate for the development of a comprehensive hearing conservation programme in the gold mine company in Zimbabwe (Musiba, 2015).

NIHL is identified as a significant public health issue worldwide. There was some evidence that the number of new cases were declining in some European countries, but increasing in others. Interestingly consistently in the surveys there is apparent increase in the number of people who believe that they were exposed to dangerous noise levels in the workplace. While it was difficult to precisely define and catalogue the disorder, somewhere in the region of 180 million people worldwide may currently be affected with a further 600 million at a high risk of developing it due to excessive noise exposure levels (Thourne et al., 2008). Construction, agriculture, manufacturing and metalworking industries show a higher prevalence of noise- induced hearing loss and the greatest losses are consistently among men above the age of 45 years. While there is no cure for those that are already affected, the condition itself was regarded as essentially preventable (Rabinowitz, 2000).

2.8 The Consequences of Noise Induced Hearing Loss

NIHL is a term that is used to describe hearing loss after noise exposure. It includes temporary threshold shifts (TTS) and permanent threshold shifts (PTS) that are caused by a variety of high intensity sounds (Sliwiska-kowalsica, 2013). TTS and PTS are the products of the changes that high intensity sounds (which will be referred to as noise within this manuscript) produce within the auditory system, including mechanical damage, excitotoxicity or overstimulation of the hair cells, and oxidative stress and production of free radicals. Intense noise exposure may cause temporary threshold shift (TTS) due to temporary effects of noise on inner ear hair cells. If the hairs cells do not recover from the noise exposure it could result in permanent threshold shifts (PTS) (Nthlakana, 2014).

The same study also indicate that the intensity of the noise involves the loudness of the sound and duration of exposure to noise which then determines whether the hearing loss has occurred. Mechanical damage to the auditory system from noise is generally caused by loud impulse noise or transient sound stimuli (i.e. gunshots) that cause physical damage to the sensitive anatomical structures (Nthlakana, 2014).

The result of excessive noise exposure is typically in both ears and result in a sensorineural hearing loss that has been caused by damage to the sensory system. In addition to a loss of hearing in the high frequencies a person will show a loss of ability to discriminate speech sounds and may also be unable to cope with loud sounds. Commonly a person with noise-induced hearing loss will complain of tinnitus which is the continuous perception of sound in the absence of any physical sound. For many in the early stages of noise- induced hearing loss the tinnitus is the most presenting symptom (Sliwiska-kowalsica, 2012).

Furthermore, this damage includes, tympanic membrane rupture, ossicular disarticulation, and the death of hair cells, especially the outer hair cells due to the intense vibrations of the noise. Once the outer hair cells die, they do not grow again. With repeated exposure to intense noise the hair cell death produces an irreversible and measurable permanent hearing loss (Lasak, Allen, McVay and Lewis (2014).

Individuals with NIHL may experience a significant morbidity due to hearing loss, concomitant tinnitus and impaired speech discrimination. Noise may cause other health effects such as stress, hypersensitivity to noise, increased blood pressure and increased heart rate (Hansell, Blangiardo, Fortunato, Floud, de Hoogh, Fecht, and Beevers, 2013). Just like what Hansell et al., (2013) indicated above, Basner et al., (2014) confirms that noise has a great effect on blood pressure. It was further noted that employees working in continuous noise zones of about 85dB(A) have been reported to present with a higher blood pressure than those who were not exposed to noise and that may also increase the risk of mortality for these workers (Basner et al., 2014).

Associated problems experienced by a person with hearing loss include depression, social isolation and increased risk of motor vehicle accidents. Depression among individuals with hearing loss is also a prevalent psychological dilemma that affects the quality of life and enjoyment (Daniel, 2007). Daniel, 2007 further reported that hearing loss may result in poor psychological function, including common breakdowns in family communication that may lead to family tension and social isolation. Close family members, particularly spouses, may experience irritation with

the need to constantly repeat verbal communication or talk loudly. Hearing loss also increases dysfunction in self-esteem, behavior, energy, stress management, performance, and social competence.

Furthermore, noise can cause impaired cognitive function. Excessive exposure to noise affects central processing, language comprehension, and attention in the form of being less able to multitask in the presence of noise (Daniel, 2007).

As far as the working environment is concerned, hearing loss affects the communication and safety of the workers during working hours therein. From an employment perspective, noise-induced hearing loss can significantly reduce an individual's ability to undertake job tasks that require the use of auditory signals or verbal communication, placing limits on the kinds of employment. Within the workplace a partially deaf individual could be perceived and labeled as incompetent, inattentive or 'difficult' due to their communication handicap, causing social isolation in the workplace and impacting upon team work and group productivity. This could be especially so in the earlier stages of hearing loss, where neither individuals nor their peers have yet realized that they have reduced hearing ability (Rabinowitz,2000).

From an organizational perspective these problems can manifest as high levels of lateness and absenteeism from affected workers, increased turnover and reduced staff turnover, reduced job satisfaction from the affected worker or their peers, and lower productivity from teams that include deafened individuals. The fact that noise-induced hearing loss is most pronounced in older age could prevent some noisy industries from retaining highly skilled and experienced staff who have been forced into early retirement due to hearing loss. Overall, noise-induced hearing loss is a disorder that can greatly affect social and economic outcomes for the individual and those around them. In a world made for those that can hear properly, deafness can strongly impact upon all facets of an individual's life (Gibson, Brammer, Davidson, Folley, Launay and Thomsen, 2013).

There are many risks for potential hearing loss. Some of these risks can be controlled through various mechanisms, such as ensuring consistent use of hearing protection devices. Avoiding tobacco, getting regular exercise, and eating a healthy diet may also decrease the risk of noise-induced hearing loss. Jin, Pegg and Carney (2013), suggested that there are also some risks that cannot be controlled like age, genetics, gender, and race. The risk of NIHL is reported to be low at an exposure of less than 85dB noise at 8-hour time weighted average but increases as exposure rises to that level. Workers with hearing loss therefore require an individualized

assessment that covers both need to communicate safely, effectively and the need for protection from additional damage due to noise (Kirchner et al., 2012).

Therefore, the impact of poor implementation of hearing conservation programme in different institutions can result in NIHL due to uncontrolled exposure to too much noise.

2.9 SUMMARY

This chapter gave a review of literature in connection with the implementation of hearing conservation in other developed and under developed countries. Hearing conservation aims to conserve the ability to hear of those who are working in increased noise areas. To bring about a structured way to fulfill this aim, various countries developed HCPs. The consulted literature revealed the situation of HCP internationally and also in South Africa. A number of organizations are involved in the structuring and implementation of HCPs and this include OSHA and the Acoustic Association of America.

It is quite evident that both developing and developed countries agree on the same maximum level of noise presentation, and that is 85dB. Developing countries studied include New Zealand, Argentina, Tanzania, Brazil, and Zimbabwe. South Africa adopted the same principles for HCPs as used by developed countries USA and Canada. The HCP elements were also discussed as part of a concern of what exactly is supposed to be done in order to protect the hearing health of workers who are exposed to noise in their working environment. The general process of HCP includes education and training of employers and employees, enforcement of legislation as per country, using HPDs, audiological testing for baseline purposes and also for monitoring purposes, and continuous monitoring of compliance to these legislations for HCP.

It is also quite evident from research conducted in South Africa that the level of compliance by industries and employers, and to some extent, employees, is relatively low. Some of the reasons mentioned for this included discomfort with HPDs, and difficulty communicating while working due to hearing impediment caused by HPDs. Companies however have been mandated to ensure that noise about acceptable levels as per HCPs should be eliminated immediately and if that's not possible, the exposure must be controlled with utmost commitment.

The literature review also indicated the impact of NIHL among workers in different places. Research worldwide suggests a significant level of hearing loss to be related to NIHL at work premises. Unfortunately NIHL not only affects hearing but the increased noise is able to damage auditory meatus and tympanic membrane. Furthermore, the impact of NIHL may lead to stress, increased blood pressure, as well as morbidity due to significant communication breakdown caused by permanent hearing loss. The following chapter will describe the study methodology.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology, which includes the research approach, design of the study, study area, purpose, study setting and population, research sample, reliability and validity of the instrument, data collection procedure and analysis, ethical consideration and dissemination of study findings.

3.2 Research design

The study utilized a quantitative descriptive cross-sectional survey design where numerical data was obtained at one place, Royal Macadamia, in time without manipulating the study environment (Grove, Burns and Gray, 2012).

The quantitative approach was used because it has been developed in such a way that the scientific methods used has a capacity of collecting relevant and reliable information making use of a questionnaire and minimizing researcher's bias rather than using interviews and observations which needs direct contact with the participants (Davies and Hughes, 2014). The researcher also used a descriptive method which also assisted in the accumulation of more information about the population that was being studied through description.

3.3 Study setting

The study was conducted at Royal Macadamia located in Vhembe District under Makhado Municipality. Vhembe district is one of the Districts in Limpopo Province and Royal Macadamia is a farm located in Levubu farming area. The farm is situated 56 kilometers west of Thohoyandou town in Limpopo Province and the major business is oil refinery from Macadamia nuts crushing using heavy and noise machinery. Their routine activities in the farm include nuts sorting, crushing, refinery, packing as well as mechanical and administration work. Most of these activities are done behind closed doors, where the machines are used. They produce cooking oil and lotion of different uses as their by-products. The farm is composed of 260 employees. However, each shift is composed of 130 people working for nine hours per day which is also important to note in this study because the more they are exposed to noise the more they are at risk of developing noise induced hearing loss if there is no hearing conservation programme in place (Kirchner et al.,2012).

3.4 Study population

Singleton and Straits, (2010) defined study population as a group of individuals that the researcher wants to draw a conclusion about once the research has been completed. The population of this study were all farm workers at Levubu farming area. The target population was all farm workers at Macadamia farm in Levubu area. The farm has about 260 male and female workers as shown in Table 1.

Table 1. Population of Royal Macadamia

Unit	Men	Women	Total
Crushing and squeezing	60	40	100
Packing	10	20	30
Mechanical	45	5	50
Administration	12	8	20
Refinery	35	25	60
Total	**162**	**98**	**260**

3.5 Sampling

Sampling is when a group of people from the total population have a chance to be selected in order to participate in a study (Rossi, Wright & Anderson, 2013). In this study, a total population study was used as the Macadamia farm had a small population. However, the sample size could not reach a total population of 260 workers because Macadamia nuts were out of season during the time of data collection.

3.5.1 The following were the eligibility criteria of the study:

- To be employed as a worker at Royal Macadamia.
- To be involved in refinery, crushing, squeezing, packing and administration.
- To have not participated in the pre- survey.

In this study a total population sampling method was used in order to increase the response rate. However the study composed of 76 participants (44 females and 32 males) due to macadamia

nuts which were out of season and all temporary workers were laid off and only few permanent workers remained.

3.6 Data Collection Instrument

Data collection is a systematic way of gathering information relevant to the research purpose or question (Edson and Klein, 2017). For the purpose of this study, a self-administered questionnaire was used to collect data. Questionnaires are instruments that are used to obtain information about the present practices, conditions and demographic data (Thomas, Silverman and Nelson, 2015). In the use of questionnaires, Mouton (2001:100) stated that researchers may either use existing instruments or develop a new one. In the case of this study, the researcher developed a questionnaire based on the literature and OSHA (Irgens-Hansen, Sunde, Bråtveit, Baste, Oftedal, Koefoed, and Moen, 2014). The questionnaire was translated from English to Tshivenda by a language practitioner in order to suit workers who were illiterate.

The questionnaire comprised of five sections; namely:

Section A - Biographical Information,

Section B- The use of hearing protection devices by employees,

Section C-The training received and knowledge of employees with regards to the implementation of hearing conservation programme,

Section D- The availability of the audiological information with regard to the implementation of the hearing conservation programme and

Section E- The availability of systems to monitor and evaluate the hearing conservation programme (See Appendix 3).

3.7 Validity of the Instrument

Polit and Beck (2010), defined the validity of an instrument as the degree to which the instrument measures what it is intended to measure. In this study, concern was given to face validity and content validity.

3.7.1 Face validity

In this study the face validity of the instrument was well ensured by aligning the questions with the study objectives in order to cover the important aspects of the study. The data collection was presented to the University of Venda higher degree committee that assisted with feedback to modify it. It was also checked by the supervisors and statistician and the suggestions and recommendations were used to improve the instruments.

3.7.2 Content validity

A content validity test checks whether there are enough relevant questions covering all aspects being studied and that irrelevant questions are not asked (Parahoo, 2006; Wilson, Pan and Schumsky, 2012). In this study, the researcher ensured the content validity of the instrument by the use of relevant literature. The instruments were submitted to language experts, occupational health and safety experts and supervisors. It was also submitted to fellow students during the departmental seminar. Comments and inputs were used to modify the instruments.

3.8 Reliability

The reliability of the study was ensured through the use of test re-test method in which the questionnaire was introduced to 10 workers from a farm with a similar characteristics as Royal macadamia. The instrument was administered to the same participants two times following the interval of one week. The results of the first participants were compared to the responses that they gave in the second occasion after one week to ensure consistency in answering questions. The results revealed a correlation coefficient (r) 0,76 and this indicated high reliability.

3.9 Pre-Testing the instrument

Pre-testing of the research instrument was conducted as a method of ensuring reliability in a neighbouring farm, Ratombo situated in Levubu. However they did not form part of this study. The prepared questionnaire was administered to 10 participants from a neighbouring farm with similar

characteristics as Macadamia farm. The participants did not form part of this study. The outcome of the pre-test results assisted the researcher in making corrections to adjust the instrument.

3.10 Procedure for Data Collection

Data collection techniques gives researchers an opportunity to gather relevant information about the people of the study and their environment where everything is happening. It should be done in a systematic way to avoid difficulties in answering the research questions (Chaleunvon, 2013).

After the researcher obtained a permission to conduct a study from the management of the farm, and an appointment was secured with the employer to make an agreement on the suitable time and place to conduct data collection. Data collection was done during the time allocated by the management of the farm in order to prevent reduction or interruption in the production. Data collection was conducted by the researcher and the research assistant. The research assistant was trained by the researcher on the purpose of the study and the research ethics.
The research questionnaires were distributed. Those who could not read and write were assisted by the researcher and research assistant. Questions were read out for them to answer. The questionnaires were completed in the presence of the researcher and the research assistant so that they may clarify any arising question.

3.11 Data Analysis

In data analysis, the data collected through research is systematically managed, analysed, organised, summarised, evaluated and interpreted (Bryman and Bell, 2015). The researcher together with one research assistant collected raw data using the questionnaires and check it to find out if there were any improper values. The questionnaire did not have names and instead codes were used. It was then sent to a statistician for analysis using the Statistical Package for Social Sciences (SPSS) version 23,0. Due to the fact that the variables were quantitative in nature, a descriptive statistic method was used in order to display the features of the sample in the form of frequency tables, pie charts and bar graphs to summarise the findings (Fang, 2014).

3.12 Ethical Consideration

Wang (2015) defines “ethics’ as the principles that rules the right and wrong behaviour. He further indicated that Chinese define it as rule to handle the relationship between people and their environment. For the purpose of this study, the researcher also considered using the following ethical principles: informed consent, confidentiality, anonymity, voluntary participation and protection of participants from any harm.

3.12.1 Permission to conduct a study

The research proposal was presented to the School of Health Sciences Higher Degree Committee (SHDC) and the University Higher Degree Committee (UHDC) at the University of Venda for quality assurance and approval. After obtaining approval from the UHDC, the researcher applied for Ethical clearance from the University of Venda Research Ethics Committee. Permission to conduct a study from Royal Macadamia Farm was requested in writing after obtaining the ethical clearance from the University of Venda.

3.12.2 Informed consent

Informed consent is when the participants freely agree to participate in the research showing that they understood what the study is all about and that they are free to withdraw their participation anytime they feel no longer interested (Punch, 2013).

The participants were informed about the purpose of the study verbally and ensured that they should feel free to withdraw from the study at any time if they were no longer interested and that only those who signed the consent forms would participate in the research. They were also informed that their participation in the study was voluntary with no tangible reward. An informed consent form with written information about the study and the rights of the participants was given to participants before the study was carried out for them to sign.

3.12.3 Confidentiality

The participants were informed that all the information collected for this research project were kept confidential. They were informed that no confidential information will be shared with any other people and no names were used.

3.12.4 Anonymity and Privacy

In this study privacy were conducted while collecting data in a private room at Royal Macadamia. The researcher requested the participants not to write their names or provide any form of identification and all consent forms were separated from the questionnaires to ensure anonymity. The researcher used codes instead of names when sorting questionnaires before they were analysed.

3.13 Dissemination of study findings

The study findings hard copy will be submitted to the Library of the University of Venda and to the management at Royal Macadamia. The results of the study will be presented at conferences and seminars. It is also envisaged that the findings be published in a relevant journal so that it will be accessible to other people.

3.14 Summary

This chapter outlined the structure that the researcher used to conduct the study. The structure composed of: research approach, study design, population studied, sampling procedures used, data collection plans and instrument used, validity and reliability, data analysis and ethical considerations. A quantitative descriptive study approach was used with the advantage of reliability and reduced researcher bias. This study was conducted at a Macademia nuts factory farm in a province of Limpopo in South Africa. The population studied was made up of all farm workers at the farm which were sampled based on their involvement in duties that place them at potential risk of NIHL which included crushing the nuts.

The researcher developed a questionnaire to aid in data collection. This instrument was developed with the guidance of a research by OSHA in South Africa. Face and content validity were established using the assistance from the higher degree committee of the University of Venda. Role players including the researcher's supervisor, language experts, and statisticians came on board to assist with modifying the instruments to achieve the level of validity required. Pretest-test-retest method was used to achieve reliability for the results from the research.

Data was collected by the researcher with her assistant, and it was analysed statistically using SPSS version 23.0. For ethical consideration the researcher applied the ethical principles including, confidentiality and informed consent, and the SHDC together with UHDC of Univen provided the ethical standard clearance for the research. As such no names were used in the research unless otherwise stated, and there was no harm inflicted upon the participants. The following chapter will describe the study results

CHAPTER 4

PRESENTATION OF RESULTS

4.1 Introduction

The purpose of the study was to assess the implementation of hearing conservation programme (HCP) among workers at Royal Macadamia in Vhembe District in Limpopo province of South Africa. The questionnaires were distributed to 76 workers who participated in the study. The study results are therefore presented in this chapter in frequency tables, percentages, graphs and pie charts according in five sections respectively (A, B, C, D and E), which are in line with the study objectives.

4.2 Demographic profile of the study participants

As shown on Table 2 below the study respondents were dominated by women who were 57.9% with male participants constituting to 42.1%. Their ages varied from 19-50 years with 19-25 years

and 31-35 years represented the highest number of respondents respectively. Most of the workers who participated in the study were in the processing 968.4%) unit with a considerable number of workers who were in the unit of packaging (31.6%).

Table 2: Demographic Profile of Participants (N=76)

CHARACTERISTICS	(N)	(%)
Gender:		
Male	32	42.1%
Female	44	57,9%
Age:		
19- 25 years	20	26,3%
26-30 years	08	10,5%
31 – 35 years	22	28,9%
36 – 40 years	11	14,5%
41- 45 years	05	6,6%
50 years and above	10	13,2%
Working Departments:		
Packaging	24	31,6%
Processing	52	68,4%

4.2.1 Working sections of the research participants

Figure 1 shows the working sections of the workers at Royal Macadamia who participated in the study. The study was dominated by the general workers (23.6%) together with the ones who worked at the table (26.3%), however another department which include administration (7.8%), maintenance (5.3%), cracking (9.2%), Buhler (11.8%) and styling (10.5%) were represented respectively.

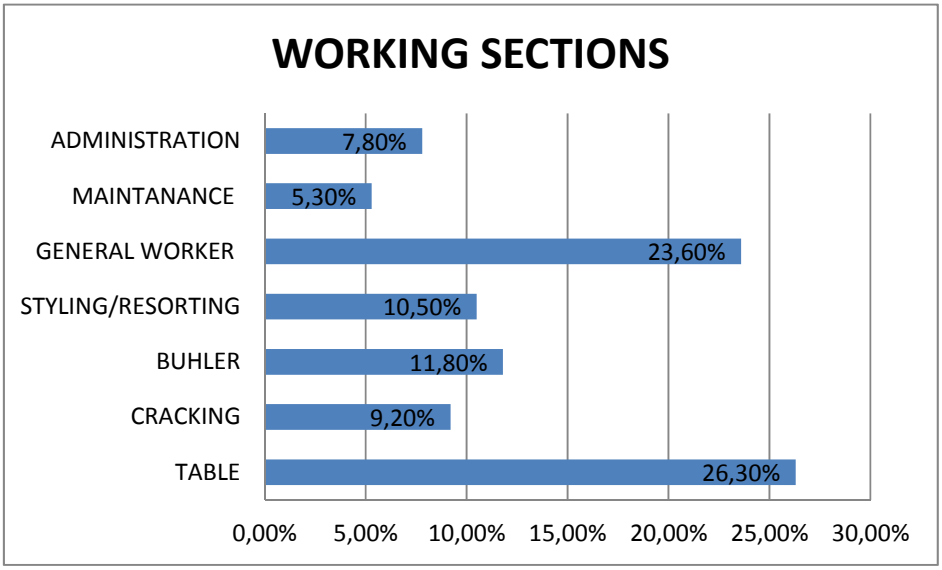

Figure 1: Percentage of workers per section or departments

4.3: The use of hearing protection devices by employee at Royal Macademia

This section of the results presentation illustrates the use of hearing devices by employees at the Royal Macadamia. The study reveals that the some of the workers (82,9%) do not use hearing

protection even though they are supplied with a resounding percentage of 67.1% of those who do not use and only 32.9% using hearing protection devices. The study further reveals (Figure 2 below) that among the protective hearing devices used at Royal Macadamia, the ear plugs are the most used ones followed by foam ear plugs and custom ear plugs respectively, however 13.5% indicated they used no hearing protection device.

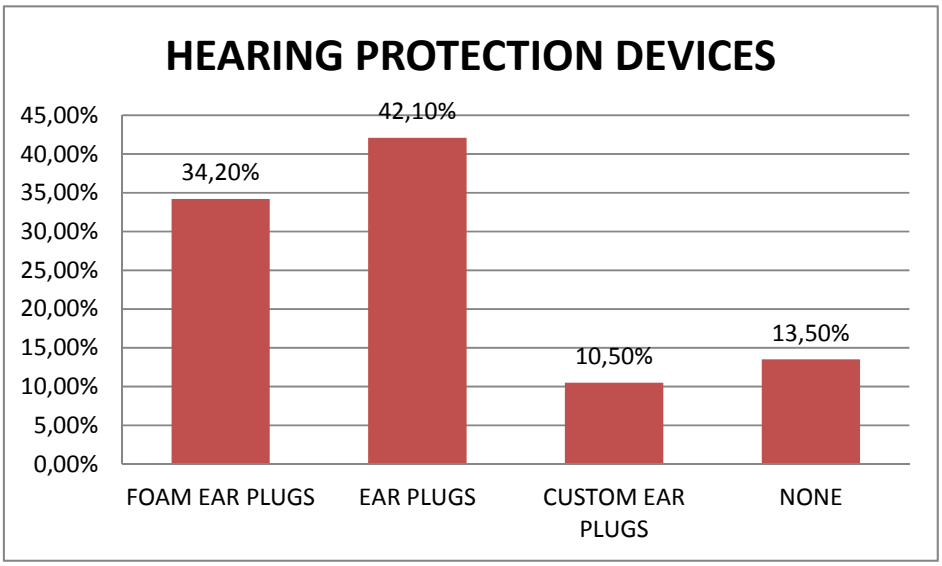

Figure 2: Hearing protection devices used

4.4 Exposure to noise and use of hearing protection devices

Table 3 below indicates the extent of exposure to noise and the aspect of the use of hearing protection devices. The study, therefore, revealed that a high percentage (85.5%) of respondents

were exposed to noise for long hours (more than nine hours) however 82.9 % of this vulnerable group were not even using hearing protective devices.

TABLE 3: Exposure to noise and the use of protection

	(N)YES	(%)	(N)	N0 (%)
EXPOSED TO NOISE FOR MORE THAN 14 HOURS	61	80.5%	15	19.7%
USE OF HEARING PROTECTION DURING EXPOSURE	13	17.1%	63	82.9%

4.4.1 Reason for not using hearing protection during noise exposure

One of the probing questions which was in the questionnaire was to identify the reasons why some workers did not use hearing protection since the majority was exposed to noise. In Figure 3 below half (50%) of the respondents indicated that they were not protecting their ears during exposure because they did not feel comfortable in their ears when they wore them. There is also lack of provision (37%) of hearing protection devices, however a small number revealed that they are not exposed (13%) to noise during their work.

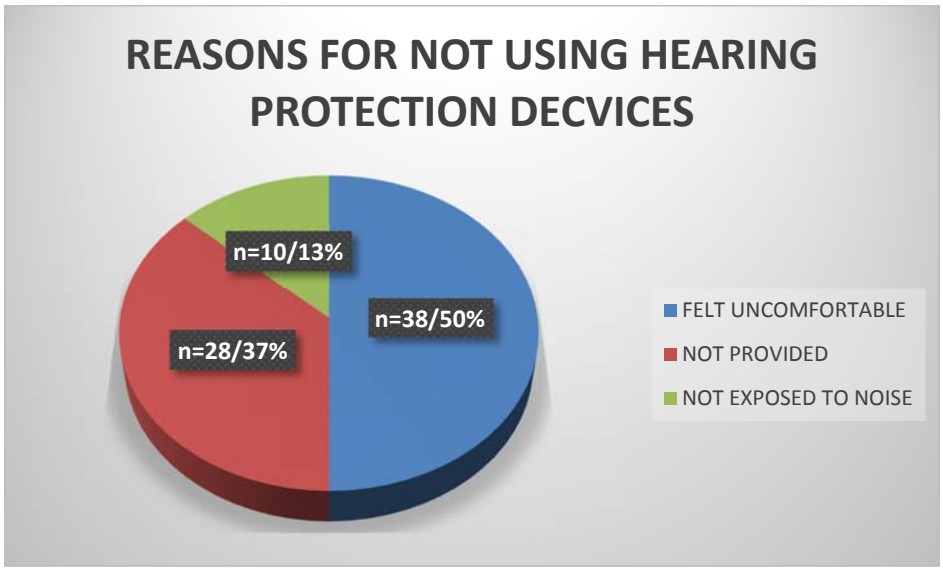

FIGURE 3: Reason for not using hearing protection during exposure

4.4.2: Exposure to noise activities over life

The majority of research participants indicated that they were not afraid of enclosed places (claustrophobic) and Figure 4 below depicts the life activities that respondents experienced which can cause problems to hearing. The large number of people who were once involved in welding (23.7%), construction (23.7%) and tractor driving (19.7%) respectively, with a small group of individuals involved in woodwork (13.2%). However 19.7% never experienced noise activities. Whilst participating in listed extra activities, only 14.5% were protecting their ears with the largest 85.5% who were not protecting their ears at all.

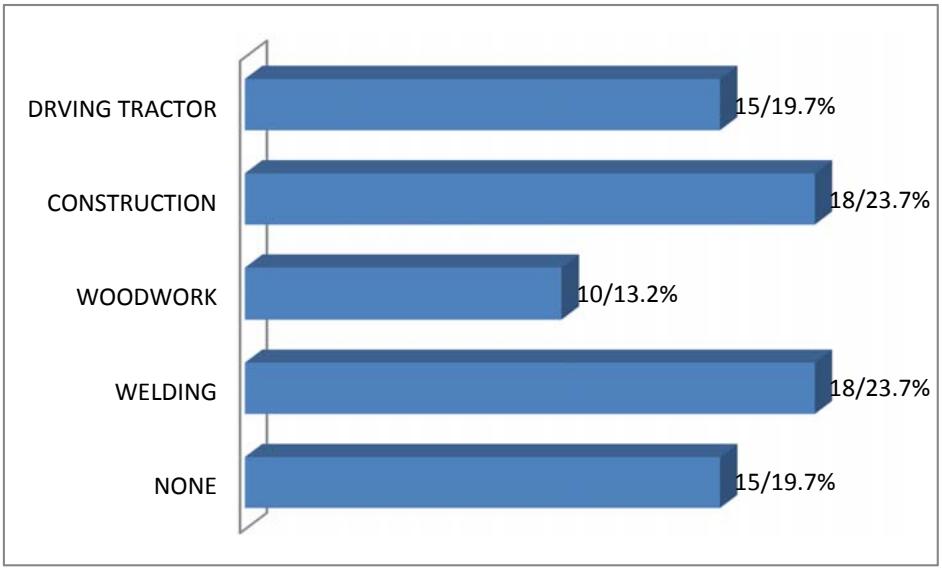

Figure 4: Noise exposure activities outside work

4.5 Training received and knowledge of employees with regard to the implementation of a Hearing Conservation Programme

One of the study objectives was to identify the training received and knowledge of workers regarding the implementation of HCP. The Table 4 below shows the results of the study on how the objectives of HCP training are fulfilled at the Royal Macadamia. The study established that all the expected objectives of hearing conservation training were not full-filled and the respondents showed a lack of knowledge about it. The training on the effects of noise on hearing was received by a quarter percentage of 25% however the large portion of the population (75%) was also not knowledgeable about the objective. The purpose including the benefits and disadvantages of

hearing protectors was indicated to have been received by 17,1% participants with all other 82,9% respondents not so informed about it. A high percentage revealed there were no Audiometric tests results available (75%) and no proper care of hearing protectors (59.2%).

Table 4: Hearing training objectives

	(N) YES	(%)	(N) N0	(%)
EFFECTS OF NOISE ON HEARING	19	25%	57	75%
PURPOSE, ADVANTAGES AND DISADVANTAGES OF AVAILABLE OF HEARING PROTECTORS	13	17.1%	63	82.9%
DEMOSTRATION ON HOW TO FIT EAR PROTECTORS	30	39.5%	46	60.5%
PURPOSE OF AUDIOMETRIC AND THE TESTING PROCEDURES	19	25%	57	75%
ATTENUATION	05	6.6%	71	93.4%
PROPER CARE FOR HEARING PROTECTORS	31	40.8%	45	59.2

4.6 Availability of audiological information with regard to the Implementation of a Hearing Conservation Programme

A very small percentage of 3.9% indicated that they had a documented hearing loss against the majority of 96.1%. However, though there was a small number of documented hearing loss, experiences related to hearing problems indicated that loud noise (44%) was the most troubling factor. Other experiences included were ringing in the ear (7%), mumps (8%), dizziness (15%)

and allergies (14%). Apart from the results shown on Figure 4.6 below, the present study revealed that no one was using hearing aids.

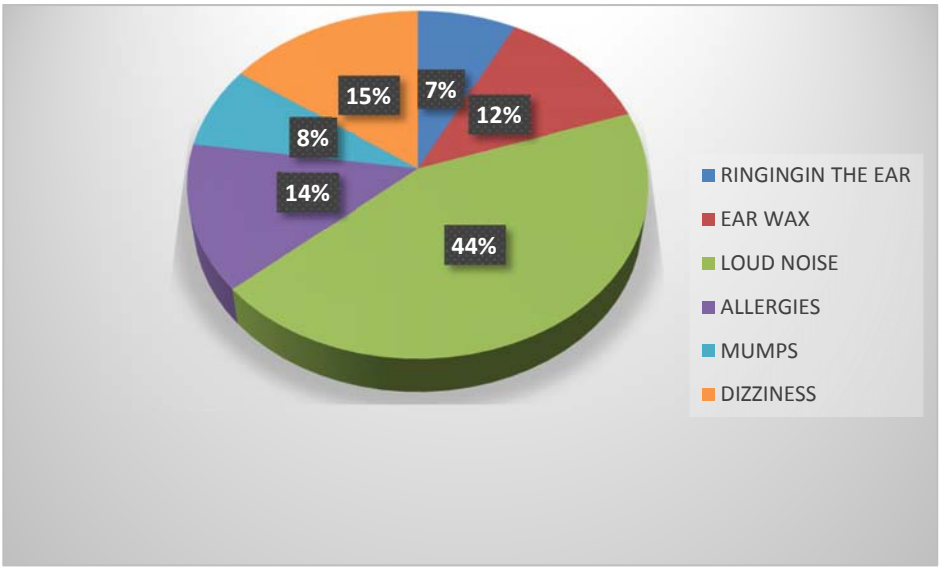

Figure 5: Experiences in relation to hearing problems

4.7 Availability of systems to monitor and evaluate the Hearing Conservation Programme

The findings show that only engineering noise controls were available. However the answer to two important aspects of monitoring and evaluations of HCP are not available as shown in Table 5 below. The study (73.7%) outlined that the area had no posted caution signs which ensures the use of protection devices, and there were (89.5%) provision of noise maps

TABLE 5: Availability of systems to monitor and evaluate the hearing conservation programme

	(N) YES	(%)	(N) N0	(%)
AREA POSTED WITH CAUTION WITH SIGNS INDICATION NOISE PROTECTION TO BE TAKEN	20	26.3%	56	73.7%
PROVISION OF NOISE MAPS	08	10.5%	68	89.5%
ENGEENRING NOISE CONTROLS PROVISION TO NEW EQUIPMENT	48	63.2%	28	36.8%

4.8 Summary

The chapter presented the results of the study and interpretation of the findings based on the analyzed data. The findings were statistically presented in the form of graphs indicating frequencies and percentages. From the results it is evident that the there were more females than males in the farm and of these workers majority were below the age of 35 which is classified as youth in South Africa. More workers were found to have other occupations outside the farm which also appeared to put them at risk for NIHL. In the farm, majority of the time of the workers was spent in increased noise environment and work.

It was also noted that there were relatively low information about the need to protect the workers from hearing loss in the workplace. An interesting finding was that many participants reported to be using hearing protection devices compared to those who were not, however less than 20% of the workers used the HPDs during the time of high noise exposure. The reasons for not using HPDs included discomfort (50%) while the rest was either not provided with HPDs or the feeling that they were not exposed to loud noise. It was also evident that majority of the participants had not received formal training regarding the need to protect their hearing in the work places. Some

of them were already experiencing NIHL induced symptoms such as dizziness and tinnitus. The next chapter is focusing on the discussion of the study findings.

CHAPTER 5

DISCUSSION OF RESULTS

5.1 Introduction

This chapter presents the discussion of the findings wherein the findings will be debated in line with literature. The similarities and practical implications of the study will also be argued and agreed to. The discussion will be presented according to the following sections: demographic information, the use of hearing protective devices by employees, the training and knowledge received by employees with regard to the implementation of hearing conservation programme, the availability of the audiological information with regard to the implementation of HCP, and the availability of systems to monitor and evaluate the HCP**.**

5.2 Demographic Information

In this study, participants were requested to indicate their date of birth, their age in years, sex and the sections where they were working. This assisted the researcher to know the kind of participants that were part of the study as far as age, sex and the working environment was concerned even though the study was not focusing much on age and sex.

It was found, however that age was not to be associated with hearing loss. This is because both adults and youth were reported to be exposed to noise in the same working environment. It was not part of this study to reveal the relationship between age and the hearing loss.

The National Institute for Occupational safety and Health (NIOSH)**,** revealed that the effect of noise is greater in males than in females. The same study further revealed that in industrial sectors more men were employed, however in this study more women were employed in this farm as shown in Table 2 (Nelson, Nelson, Concha-Barrientos and Fingerhut, 2005).

5.3 The use of Hearing Protective Devices (HPD) by employees

In this study, 42.1 % of the workers indicated that they were using ear plugs which indicate that the farm supplied them to protect their hearing. Despite the availability of hearing protective devices, the literal act of using them remains a challenge while the rate of acquiring noise induced hearing loss increases within the agricultural setting (Shermanl and Azulay, 2014).

The use of HPDs is a simple and familiar method available to protect hearing mechanism. There are different types of HPD which include the ear muffs, ear foam plugs and personal ear plugs. However, ear plugs fall among the common hearing protective devices used because they are cheap, easy to use, effective sound protection, comfortable and user friendly (Barwacz, 2015).

According to the findings of this study, hearing protectors were used as the main method to reduce noise exposure thereby preventing noise induced hearing loss. It was also noted as their major means to participate in the implementation of the hearing conservation. The participants seemed reasonably aware of the use of hearing protective devices, which was a great highlight of progress. Some of the participants were observed with hearing protection devices hung on their shoulders during lunch time which may indicate that they were using hearing protection.

In this study, the participants confirmed that hearing protection devices were supplied free of charge. Given the fact that the study results revealed that workers were exposed for long hours to noise without protecting their ears, it gives uncontested assumption that they might suffer hearing loss in the future. Some of them had started complaining that they were experiencing ringing in their ears after leaving the noisy working environment.

The study results indicated that about 50% of participants showed no interest in the use of ear protectors. Most of them indicated that they did not feel comfortable working with hearing protectors on their ears. The issue of an attitude towards the use of hearing protectors has an impact on the fight to reduce NIHL. A study conducted by Keppler, Dhoogel and Vinck (2015), revealed that young people believed that noise exposure or hearing loss is not a problem even though they ended up presenting with a hearing loss.

Over exposure to noise outside work environment have a serious impact to someone's hearing. In this study the findings indicated that 23,7% of workers had been exposed to noise outside farm working hours, while doing their own activities such as welding and construction. It is therefore imperative that the implementation of a hearing conservation programme should be done anywhere in any type of activity where people are exposed to too much noise.

As far as the correct implementation of hearing conservation programme is concerned, the use of hearing protectors should be taken as the last option. It is possible that the reason hearing

protective devices were preferred was motivated by cost effectiveness as compared to other intervention options. Furthermore, according to Nthlakana (2014), hearing protective devices can be customized to suit individual's work and personal needs.

5.4 The training and knowledge received by employees with regard to the implementation of HCP

The study requested participants to indicate areas in which they were trained in order for the researcher to find out whether workers were well informed about the implementation of a hearing protective devices.

According to the Occupational Health and Safety Administration (OSHA), employees who are working in a noise zone are supposed to be trained on issues pertaining to the effects of noise on hearing, advantages and disadvantages of HPDs available, and a practical demonstration on the use and proper care of the HPDs (OSHA, 2002).

In this study, 75% of the workers indicated that they were not trained on the effects of noise on hearing. This pose a great risk of developing noise induced hearing loss, since they do not have any information about what could happen to their ears if they are exposed to noise. As part of the HCP done in Singapore in 2010, it was stated that a worker is not supposed to be exposed to noise that exceed the permissible level limit of 85dBA for more than eight-hours per exposure (Zhihan, 2010). The main aim of training and educating employees is to increase employee awareness of noise hazards and the need for using HPDs. This type of training needs to be conducted at least once every three years (Zhihan, 2010).

Noise can cause permanent damage to the hearing system. Slight exposure to noise may cause temporary change in your ears like feeling ringing in your ears, fullness sensation of which some of the workers in this study were complaining about. Repeated exposure to loud noise may also lead to permanent hearing loss that could not be corrected by any surgical procedures. This can be profound limiting employees to hear high frequency sounds. Difficulties in comprehending speech conservation may pose a negative impact in communication thereby putting the workers in environmental dangers (Basner et al., 2014).

5.5 The availability of the audiological information with regard to the implementation of HCP

The study revealed that lack of documentation of previous hearing tests results suggest the possibility of no previous audiometric tests carried out in order to identify those who were at risk so that implementation of a hearing conservation programme could be put in place. Murphy and Griest (2014), doesn't support the neglecting of audiometric testing as they attested that during the Art of Hearing Conservation conference held in St Petersburg Florida in USA. The papers that were presented on hearing conservation through education, prevention and identifying mechanisms of hearing loss were given attention.

Other researchers believe that occupational hearing screening is an important part for hearing prevention programme (May, 2000). However, there are variations in different countries concerning the allowed levels of exposures to noise and the noise exposure levels without hearing protections. Most developed countries recommended the implementation of a hearing conservation programme. Further to that the Acoustical Society of America recommends that the audiometric testing component of hearing conservation programmes be administered yearly wherever possible, and at no more than two-yearly intervals elsewhere so that established criterion ranges remain equitable (Thorne et al., 2008).

As part of HCP, monitoring each worker's hearing over time very important. Audiometric testing provide opportunity for employers to educate their workers about their hearing status and need to protect it. There should be continuous audiological tests available at no cost to every worker who is exposed to noise at 85dBA or above. When records of tests are available it also assists the employer to make follow ups in order to find out if the HCP in place is really preventing the hearing loss. The important records to be kept include: base line audiograms that are usually conducted when employee starts working within 6 months of first exposure and an annual audiogram that should be completed once a year. Employers must also keep a record of hearing losses that are caused by anything outside work. This may need an audiologist who will be able to do more tests to determine if the loss was work related or not (Basner et al., 2014).

5.6 The availability of systems to monitor and evaluate the HCP

According to a study conducted by O'Brien, Driscoll and Ackermann (2016), monitoring of a hearing conservation programme needs continuous monitoring through evaluation of the programme, educational programmes and annual audiological assessment. Different methods may also be implemented including monitoring noise exposure programmes, plotting noise maps, supply of good quality HPDs, monitoring of engineering controls and planning a continuous educational programmes in order to keep workers on focus and motivated.

In this study, findings revealed that the farm doesn't have enough monitoring and evaluation systems in place. It is therefore difficult for workers to adhere to the hearing conservation programme principles. There was a bit of confusion because about 26,3% workers indicated that they have seen posted signs indicating noise protection in their working environment, but the majority 73,7 % of the workers reported that they have never seen those posters.

According to the South African Occupational Health and Safety Act (Act No. 85 of 1993) as amended, stipulate the use of posters in the work place to ensure safety of the workers. If the work environment does not have posters it is an offense as it is contrary to the Act. The same Act supports the aspect of hearing conservation by stating that everyone has the right to an environment that is not harmful to someone's health and well-being. The use of hearing conservation programme has become a powerful health promotion tool to both the employer and the employee in an effort to protect the health of workers at their work-places.

A study conducted by McTaghe et al., (2013), presented a new monitoring and evaluation technique that were reported to be effective by the participants. This is another strategy that the current study area may attempt to implement in order to make sure that monitoring is done on daily basis to make workers get used to the programme.

Hoare (2014), revealed that the legal frame of South Africa emphasizes that hearing conservation programmes are mandatory, hence the practice of HCP was found to be just associated with negligence in most of the industries. This insight can be related to Royal Macadamia where maybe ignorance had an influence in the situation.

In this study the most common method of monitoring HCP was through the use of engineering methods. There are different methods of monitoring such as forming a task group to oversee the programme, implementing and managing noise exposure controls on continuous basis. They could also make use of educational materials like pasting more posters than they have done. Another method of monitoring may include continuous effective education and audiometric tests as they process macadamia nuts every year (O'Brien et al., 2015).

A study by Michael (2013) tends to bring light and solutions to address the problems of lack of monitoring systems as identified by the present study. Michael (2013) attested that continuous monitoring of personal noise exposure is a new approach to industrial hearing conservation and it is straight forward and simple solution to an often vague and difficult problem, based on a classic tenet of industrial hygiene.

5.7. Summary

This chapter outlined the discussion of the results obtained from the study. The results were discussed and supported by literature. The study reveals a contrast to what is popularly known about employment ratios between males and females. In this study more females were employed than males. The study revealed that the employees were not using hearing protection devices when needed the most due to various reasons including lack of understanding of the reasons behind need for HPDs, as well feeling of discomfort when using HPDs.

The farm issued hearing protection devices such as ear plugs to their employees for free. Unfortunately without training and monitoring of use of HPDs, this provision made little to no difference. The contrasting views from employees about the presence of hearing conservation posters and information on the farm was alarming. The greater number of those having not seen the posters as compared to the less than 30 % of those who claim to have seen the posters suggests that the level of compliance by the farm to HCP is questionable. Furthermore there was increased percentage of untrained employees regarding hearing protection in the farm. The researcher also noted lack of records to indicate monitoring of hearing levels and HCP in the farm. This is a violation of the act by OSHA. It was for this reasons that the researcher concluded that the farm was not complying with the implementation of a hearing conservation program. As a result this suggest that there is great room for improvement regarding monitoring of implementation of HCPs by industries which places employees most at risk of NIHL. The following chapter will discuss the summary, conclusion, recommendations and limitations of the study.

CHAPTER 6

SUMMARY, CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

6.1 Introduction

This chapter presents the summary, conclusions, recommendations and limitations based on the objectives of the study. The study purpose was to assess the implementation of a hearing conservation programme among farm workers at Royal Macadamia.

The objectives of the study were as follows to:

- Assess the use of hearing protection devices by employees;
- Assess the training received and knowledge of employees with regard to the implementation of hearing conservation programme; and
- Assess the availability of the audiological information with regard to the implementation of the hearing conservation programme;
- Assess the availability of systems to monitor and evaluate the hearing conservation programme

6.2 Summary

The summary of the study findings will be discussed under each study objective.

6.2.1 Objective 1: The use of hearing protective devices by employees

This study revealed that employees at the Royal Macadamia were aware of ear plugs and some confirmed that they were supplied by their employer in order to protect their hearing. This was a good and acceptable attempt done by the farm owners because it indicates that at least they were aware that they need to do something about their employees' protection against noise included hearing loss. However, even though the majority of these workers were not using hearing protection in their noisy working environment, some of them were observed hanging their Hearing protection devices on their shoulders during lunch time. Something that also attracted the researcher was the fact that the farm hygiene practices was good and this makes one to wonder whether the workers were not really trained on the use and care of the Hearing protective devices.

The participants further reported that the reason for not protecting their hearing was because they did not feel comfortable wearing ear protectors and they did not want anything in their ears.

6.2.2 Objective 2: The training and knowledge received by employees with regard to the implementation of HCP

The findings of the study revealed that participants were not using ear protectors because the training on the effects of noise on hearing were received by a quarter of them with the rest of the seventy-five percent not trained. As far as benefits and advantages of using supplied ear protectors is concerned, a higher percentage of workers also indicated that they were not trained.

6.2.3 Objective 3: The availability of the audiological information with regard to the implementation of HCP

In this study, few participants indicated that they have documented hearing loss showing that they were tested on site but the rest of the participants, about 75% of them have no records available. Some of the participants presented with tinnitus, dizziness and temporary hearing loss that were noted after leaving the working area.

6.2.4 Objective 4: The availability of systems to monitor and evaluate the HCP

The study findings indicated that there were posters indicating noise protection so as to demarcate the area and to remind workers that they are entering a noise zone that needs ear protection. Majority of the participants in this study reported that they have noted engineering control available. This also indicate much efforts that the farm management has been doing concerning the implementation of hearing conservation programme.

6.3 Recommendations

The following recommendation have been outlined according to relevant stakeholders:

6.3.1 **Recommendations for Royal macadamia management**

- Employers should have a hearing conservation policy and a service operational plan (SOP) in place that will help them to have a comprehensive programme.
- Roles and responsibilities of various stake holders in HCP should be explained in details.
- There is a need to set a programme to monitor hearing conservation programme
- Employers need to train workers on the effects of noise on hearing.
- There is a need to train workers on the use of ear plugs including the advantages and disadvantages, how to wear them, how to take care of them, when and where to wear them together with the importance of wearing them,
- Workers need training on monitoring signs or posters available, engineering controls and show them noise maps for them to be aware of all areas demarcated,

- Keeping audiological test records available as part of monitoring workers hearing status
- Keeping a record of hearing losses caused by other activities outside work will be of good assistance,
- Establish a task team that could monitor the hearing conservation programme in working environment will assist employers to have a smooth running of the hearing conservation programme.
- Workplace noise assessment should be conducted in order to see the level of noise that workers are exposed to on daily basis,
- Audiological assessment need to be conducted in order to monitor worker's hearing loss,
- Noisy equipments and tools exceeding 85dB(A) must be identified and demarcated;
- Health and safety representatives should be involved in the implementation of noise control, and
- Supervisors and managers must wear HPDs in demarcated noise zones in order to model this habit to workers.

6.3.2 Recommendation for policy makers

- There is a need for South Africa to have its own hearing conservation programme like what other countries have which will include other industrial sectors like farming.
- There is also a need to establish policies regarding noise effects for employees who are working in farms in order for them to protect their ears.
- Open noise pollution should also be prohibited because it has a negative effect on the hearing systems.

6.3.3 Recommendations for employees

- Need to work hand in hand with their employers in order to implement an effective hearing conservation programme with a positive attitude,
- Encourage to wear ear protectors in noisy working environment at all times;
- Encourage to note and follow the monitoring posters, engineering controls and read noise maps in order to keep reminded of the demarcated areas.
- Practice wearing ear protectors and take care of them to avoid worn out unnecessarily;

- Develop a positive attitude toward taking care of their health including protection of their ears; and
- To avail yourselves during audiological test which will assist them to know their hearing status

6.3.4 Recommendations and suggestion for further research

Based on the study findings, the following conclusions were made in line with the study areas.

Despite the provision of hearing protection devices, majority of workers were not using hearing protectors. The study indicated that ear plugs were the main utilised method to reduce noise exposure. There was a large number of participants who were exposed to noise for more than nine hours and yet few of them used ear protection. Their main reasons for not protecting their ears included the uncomfortable feeling and poor supply of hearing protection devices. Activities outside working environment such as driving tractors, welding and working in a construction companies were reported as other experiences may contribute to the damage of the hearing system other than the noise exposure at work.

The study further revealed that participants were not trained about the problems of noise on hearing. The results further showed that participants were unable to see the need to wear ear protectors maybe due to lack of knowledge. The participants did not have their audiological records available. This may mean that there were no continuous audiological tests conducted as part of monitoring their hearing status. Even though the farm managers and supervisors had an idea of what were supposed to be done as part of hearing conservation programme, there is a need on the smooth continuation of this programme. This will also assist the management to keep their employees aware and well informed about hearing conservation.

6.5 Limitation of the study

The targeted sample was 260 workers but due to macadamia nuts going out of season during the time of research only 76 workers managed to participate. Therefore, the results may not be generalised to all farm workers in Levubu area.

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APPENDIX 1: CONSENT LETTER

Statement concerning participation in a research project:
The title of the study is: An assessment of the Implementation of hearing conservation programme: A case study of farm workers in Vhembe District, Limpopo Province, South Africa.
I have read the information on the aims and objectives of the proposed study and I was provided with the opportunity to ask questions and given adequate time to re-think about the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurised to participate in anyway.

I understand that participation in this study is completely voluntary and that I may withdraw from it at any time and without supplying reasons, and that my purpose will not affect me anyhow. I am fully aware that the results of this study will be used for scientific purpose and may be published. I hereby give consent to participate in this study

Place:……. Date:…….

Signature:…….

APPENDIX 2: INFORMATION SHEET

Title of the research: An assessment of the Implementation of hearing conservation programme: A case study of farm workers in Vhembe District, Limpopo Province in South Africa.

Researcher's Name: Ratshulumela Thinawanga Patricia
Student number: 11636382
Email address: pratshilumela@webmail.co.za
Supervisor: Dr N.S Mashau
Co-Supervisor: Dr D.U Ramathuba

Dear participant

You are kindly invited to participate in a research study. The purpose of this study is to assess the implementation of a hearing conservation programme amongst farm workers in Vhembe district, Limpopo Province, South Africa. The procedure includes filling in of the questionnaire. You are free to ask question about the study and your participation is completely voluntary and that you may withdraw from the study at any time without supplying reasons.

The researcher will allow respondents to fill in the questionnaire while present but ensuring privacy at all cost. Those who cannot read nor write will be assisted by the researcher. Data will be handled in a confidential way with no unauthorised people allowed to touch it. It will be kept safely and will be discarded as soon as the study is completed.

The researcher will explain the format of the questionnaire to the participants and inform them not to write their names in order to protect their identity and only codes will be used to ensure anonymity.

The researcher will ensure that the respondents are not exposed to physical, psychological or emotional harm during the process of conducting a study. The respondents' positive participation in this study will enable the researcher to draw conclusions from the study and be able to give recommendations to the farm and other relevant stake holders.

The results of this study will be used for scientific purposes and may be published. Thank you for participating in this study.

APPENDIX 3: QUESTIONAIRE

Dear participant

Thank you for participating in this study.

QUESTIONNAIRE

SECTION A: BIOGRAPHICAL INFORMATION

Date of Birth:……

Company Name:……..

Job title:…….

Please provide answers to the following questions or mark with a cross where applicable e.g.X

Age (in years)

19-25	
26-30	
31-35	

36-40	
41-45	
50+	

1. Gender

Male		Female	

2. In which section/activity are you currently working?

Packaging		Processing	

SECTION B:THE USE OF HEARING PROTECTION DEVICES BY EMPLOYEES

3. Do you wear hearing protection?

Yes		No	

If Yes, what type?

Foam Ear Plugs	

Ear Muffs	
Custom Ear Plugs	
None	

4. Have you been exposed to loud noise in the past 14hrs without protection?

Yes		No	

If no, did you use hearing protection-while in the noisy area?

Yes		No	

5. If no, why? .....
6. Are you clastrophobic (Fear of enclosed places)?

Yes		No	

7. Please check ALL of the following that you have EVER done in your lifetime:

Hunting

☐ Welding

☐ Woodwork

☐ Construction

☐ Driving a tractor (Open and enclosed)

☐ Other activities, please specify……

Have you always used hearing protection when participating in the above activities?

Yes		No	

SECTION C: THE TRAINING RECEIVED AND KNOWLEDGE OF EMPLOYEES WITH REGARD TO THE IMPLEMENTATION OF HEARING CONSERVATION PROGRAMME

8. Did you receive training on the following objectives:
   a. Effects of noise on hearing

Yes		No	

b. Advantages and disadvantages of available hearing protectors.

Yes		No	

c. Fitting the appropriate hearing protector and demonstration of its fitting and use.

Yes		No	

d. Purpose of audiometric testing and the testing procedures.

Yes		No	

e. Purpose and benefit of hearing protection.

Yes		No	

f. Attenuation – What it is and how to use it to select the proper hearing protector.

Yes		No	

g. Proper care of hearing protectors.

Yes		No	

SECTION D: THE AVAILABILITY OF THE AUDIOLOGICAL INFORMATION WITH REGARD TO THE IMPLEMENTATION OF THE HEARING CONSERVATION PROGRAMME

9. Do you have documented hearing loss

Yes		No	

If yes , in which ear(s)?

☐ Right

☐ Left

☐ Both Ears

10. Who performed your hearing test?.....
11. Please kindly check ALL that you have experienced:

Ear fullness	
Ringing in the ears	
Ear drainage	
Head injury	
Ear wax	
Dizziness	
Mumps	
Diabetes	
Loud music	
Chemotherapy	
Allergies	
Other: Specify	

12. Have you ever worn a hearing aid?

Yes		No	

If YES: on which Ear?

☐ Right

☐ Left

What size?

Behind the ear hearing Aid	
In the Ear hearing Aid	
In-the-canal hearing Aid	
Completely in the canal hearing Aid	

SECTION E: THE AVAILABILITY OF SYSTEMS TO MONITOR AND EVALUATE THE HEARING CONSERVATION PROGRAMME

13.Are all areas and equipment posted with caution or signs indicating noise protection measures to be taken?

Yes		No	

14. Are employees provided with noise maps?

Yes		No	

15. Are Engineering noise controls implemented for new equipment or new facilities?

Yes		No	

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mrs TP Ratshilumela

Student No:
11636382

PROJECT TITLE: **An assessment of the implementation of the hearing conservation programme: A case study of farm workers in Vhembe District, South Africa.**

PROJECT NO: SHS/16/PH/06/0806

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
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Mrs TP Ratshilumela	University of Venda	Investigator - Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: June 2016
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

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