Non-occupational Exposure to Silica Dust at ga-Maja Village in Polokwane, Limpopo Province

By

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A Mini Dissertation submitted in partial fulfillment of the requirement for the degree of
Master of Public Health

At

The School of Health Sciences
Faculty of Sciences, Health and Agriculture

University Limpopo

Turfloop campus

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October, 2006

Declaration

I declare that the work herein submitted as a dissertation for Master of Public Health resulted from my own investigation and that it has neither wholly nor partially been presented as a thesis for a degree in this University or elsewhere.

Work by other authors that served as sources of information have duly been acknowledged by references to the authors.

……………………………………….

Kekana Mokoko Percy

(Student)

August, 2006

DEDICATION

I am dedicating this document to my entire family.

Acknowledgements

I would like to thank the following people who contributed a lot for the success of this project.

First I would like to thank ***'Bra Mike' Mr. Michael Matamela*** for introducing the degree to me. Without his unselfishness I would not have registered for the degree in the first place.

I would also like to thank my sister ***Ms. KE Kekana*** for networking and the support since I started this degree, thanks a million times.

A big thanks to ***Dr. MBL Mpolokeng*** for your assistance throughout. I would also like to thank you for arranging nice transport, accommodation and lectures at the University of Pretoria every time I went there to attend my courses.

To ***Dr. HE Onya*** a special thanks for assisting me all the time since I started the degree.

I would also like to thank the administration staff at Turfloop (**Kholo**) and at Pretoria University ***Ntate Reuben Sehone*** and ***Chantelle Maritz*** for the hard work, keep it up.

Another special thanks to ***Prof. Kuku Voyi*** for your assistance since day one when I first met you in your office. You might have not noticed it but that first day in your office opened the way for what I later called my Research Proposal. Your unselfishness will never go unnoticed. As I once said to you, May God Bless you and your Family.

I would also like to thank **Dr. Janine Wichman** for the role that she played in Environmental Health, keep it up and good luck.

To ***Mashele MP*** who was always with me during data collection, especially during dust collection. You contributed 30% towards the success of this project.

To **Mrs. Rita Olwagen**, the Statistician at the University of Limpopo, *baie dankie vir al die werk*. To **Dr. Legesse Kassa** from the Statistics and Operations Research department, also a big thank for your assistance.

To **Mr. Maswanganyi C**, University of Limpopo Chemistry Laboratory Technician thank you for the good work that you did in analysing and interpreting dust samples for me.

To **Mr. Matsobane Kekana** from the Mathematics and Computational Sciences I also say thank you very much for assisting me with calculations.

To **Mr. Montjane** who is the school Principal at gaMaja keep up the good work.

Another very big thank you to Mrs. **Maleka Sekoala** for doing my work while I was away in Pretoria.

All my classmates at Turfloop and UP, I will never forget Edupark, Bophelo and Demo Rooms and Building 22 at CSIR, Brummeria.

And to everybody who helped me, your efforts are appreciated.

Above all, thanks to God for everything!

Abstract

Introduction

Studies conducted on people who reside next to dust producing mines and industries show major health risks. Air pollutants from the mine and industries are inhaled by exposed miners and people who live in the vicinity (Steenland, 1995).

Aim

The aim of the study is to investigate non-occupational exposure to silica dust at gaMaja village in Polokwane, Limpopo Province.

Methodology

Study design

For this study a cross sectional descriptive study design was used.

Study site

The study was conducted at gaMaja village near Polokwane in the Limpopo Province

Sampling

A total sample of 200 villagers participated in the present study.

Data Collection

Two hundred questionnaires were used to collect survey data and were coupled with four dust deposition gauges. The four gauges were mounted at four different positions in the village and were left for six hours.

Data Analysis

Questionnaires were analysed using SPSS computer software to determine silica-related illnesses and indicators of exposure to silicosis susceptibility.

Dust samples from dust deposition gauges were analysed using a Varian 110 atomic absorption spectrometer for determination of silicon.

Results

The majority of both male and female participants reported that they do not wheeze (81.4%) or bring out phlegm from their chest (71.4%) as compared to those who reported episodes of cough (48%). Gauges were able to identify exposure to a particular pollutant, silica dust, and were successful.

Discussion

Data from questionnaires revealed that villagers do not show signs and symptoms related to silicosis, however, that does not rule out infection in a long run.

The results from dust samples that were collected reveal that there are traces of silica (crystabolite) in the village of gaMaja. Dust samples were collected during normal production at the mine in the middle of summer.

Conclusion

Findings from this study show that people residing next to dust producing mines and industries are at high risk of health hazard. Mining companies and policy makers should take note of the findings while planning preventive strategies for reduction of air pollutants.

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CHAPTER 1.

This chapter presents general introduction to silicosis and defines concepts that are used in the discussions to follow.

1.1. INTRODUCTION

The plight of people who reside next to dust producing mines and industries is a big concern worldwide. South Africa employs many people in different sectors and mines are one of those sectors. Operating mines have severe adverse effects on workers, the environment and the health of people who reside in areas near those mines (Steenland, 1995).

Environmental contaminants found in a community or occupational settings have long been thought to be related to a wide range of adverse health effects in humans. In the course of daily activities, humans are exposed to a variety of environmental contaminants through the air they breathe, food they eat and materials that contact their skins. These events occur in many settings, indoors and outdoors, mainly residential, industrial and occupational (Baker, et al, 1999).

Despite the existence of legislation (Occupational Health and Safety Act, Occupational Diseases of Mine Workers Act and Basic Conditions of Employment Act), government authorities and mining industries have not committed themselves to the requirements of the law and there are no proper measures that have been put in place to address the health and safety requirements of the communities (National Association of Clean Air, 1996).

Natural, social and human side effects from the mining industries have been ignored for ages; thus a lot of environmental and occupational problems have been significantly produced.

Air pollution is a severe environmental problem that results in health problems that include irritation of the eyes and skin and sometimes cancer. Dust can affect people and their environment in various ways. When the concentration of dust as a pollutant increases without being dispersed, serious problems might occur (Sundaram, 2003).

Prolonged inhalation of dust containing crystalline silica can lead to a lung disease called silicosis. Silica is a chemical compound silica dioxide that occurs in crystalline and non-crystalline forms. It is usually found in more than one form, one being alpha quartz. This quartz is a component of soil and rock. The quartz content of ordinary building materials such as concrete, mortar and bricks is about 10 – 50%. This shows how dangerous drilling or blasting quartz is, especially if one is exposed to dust particles for a long time.

Repairs and preparation of concrete building by means of mechanical tools resulted in increased concentration of dust containing quartz in Denmark (Brendstrup, 1990).

When silica is inhaled, it causes inflammation of the lung tissues, leading to scar tissue formation on the lung and that would obstruct the flow of oxygen into the bloodstream (Sundaram, 2003). Figure 1.2 shows a lung of a miner exposed to silica dust that has small black nodule. Figure 1.1 shows a normal lung that was never exposed to silica dust.

Figure 1.1 Normal Lung

Figure 1.2 Silicosis

(Small black nodules in the lung of a miner)

Sources: SORDSA

Silicosis is mostly found in adults over 40 years. It has four forms:

- Acute silicosis develops within six months to two years of intense exposure to silica dust. The patient loses a great deal of weight and is constantly short of breath

- Chronic silicosis that may take 15 or more years of exposure to develop. It may progress to more advanced forms if not treated.
- Complicated silicosis is noticeable in patients who have shortness of breath, weight loss and extensive formation of fibrous tissue in the lung. Such patients are at risk for developing tuberculosis (TB).
- Accelerated silicosis appears after 5 – 10 years of intense exposure. The symptoms are similar to those of complicated silicosis (Parker, 1996).

An epidemiological study conducted on mine and factory workers exposed to quartz dust while busy grinding, sandblasting or quarrying, discovered that exposure assessment needs to be done as most of these workers are infected and if not treated early, silicosis might develop (Moodley, 1999).

Attempts are being made to address environmental concerns by recently promulgated legislation; this includes Environmental Management Programme Reports, Environmental Impact Assessment and the National Environmental Management Act of 2000. The concerns of the community have almost never been addressed but the Constitution of 1994, together with the Bill of Rights allow communities to raise their concerns (Moodley, 1999).

1.2. DEFINITION OF CONCEPTS

The following key concepts are defined for clarification purposes:

1.2.1. Air monitoring is the use of specialised equipment to measure types of pollutants and their concentration in the atmosphere.

1.2.2. Fibrosis is the scarring of the lungs due to breathing harmful dust or chemicals such as crystalline silica.

1.2.3. Crystabolite is a white mineral found mostly in volcanic rocks.

1.2.4. Grinding is a process of sharpening the stone and to remove unwanted material from the stone.

1.2.5. Sandblasting is a process for cleaning metal and other surfaces using sand in a high-pressure air-steam.

1.2.6. Silica; fine particles from ground rock containing a high content of crystalline silica.

1.2.7. Silicosis is a nodular fibrosis of the lungs and shortness of breath caused by prolonged inhalation of silica-containing dusts.

1.2.8. Quarrying is the extraction of non-ore materials such as limestone, sand and gravel from open pits.

1.2.9. Quartz is a hard glossy mineral consisting of silicon dioxide in crystal form; present in most rocks, especially sandstone and granite.

CHAPTER 2

LITERATURE REVIEW

This chapter focuses on how International and South African authors have theorised and conceptualised their findings.

2.1. INTERNATIONAL PERSPECTIVE

Studies on silica and silicosis conducted previously were done only in mining industries and factories. One such study was in workers using hand-held grinders to smooth poured concrete surface, where personal breathing zone samplers were used to measure respirable particles and crystalline silica for exposed workers (Echt, 2002).

The procedure used for the study included a battery operated sampling pump and participants wore those pumps. The pumps were then collected daily for analysis.

Analysis was done using x-ray diffraction and to determine if there was any interference in the material, bulk samples were collected and analysed qualitatively for quartz and cristabolite (Echt, 2002).

In a study conducted by Hamilton, it was discovered that vacuum cleaners used either at homes or workplaces were exposing human beings to different environmental pollutants. Vacuum cleaner performance in a small glass-blazing factory in the USA was used to measure the capacity of the cleaner bag and the static pressure and airflow. The capacity of the bag was measured using a portable electronic scale to weigh the empty bag. To measure the air velocity in the vacuum cleaner nose, airflow was calculated. It was then discovered that there is no crystabolite in any of the air samples of the concrete dust. This study discovered that not all environmental pollutants contain silica (Hamilton, 1999).

A population-based control study undertaken in rural Japan area of Tobi concentrated on workers in factories producing refactory bricks. The area was known for its pottery production and most of the local people were employed there. Among workers and non-workers in the area, there were a large number of silicotic patients. It was suspected that they might have inhaled crystalline silica that was classified as carcinogenic to humans (Tsuda, et. al, 1997*)*.

Death certificates and chest x-ray findings were used for those who died of silicosis or lung disease when data was collected for the study. Those in the 70-79 age category had more lung diseases and among those working in brick and quarrying industry, the 60 – 69 age category was most affected. The level of silica dust was measured at 2,77 mg/m^3 (Tsuda et. al, 1997).

In Mererani area in the Northern part of Tanzania, workers were exposed to high median levels of different kinds of dust (Bratveit, 2002). Dust exposure, especially in the mining industry, was high during underground small-scale mining. Workers were exposed to respirable dust, crystalline silica, respirable combustible dust and total dust. Exposure happened mostly during drilling, blasting, loading and shoveling. Workers were exposed to silica dust of respirable size and there were threats of silicosis and lung cancer (Bratveit, 2002).

A study that was done in Kano State of Nigeria proved that exposure at homes was related to cases of silicosis. Many grindstones that were used in homes were quarried from sandstones in small group villages. A total number of 126 stone cutters were selected from two of the villages and 49 of them had radiographic evidence of silicosis. At least 17 of them had progressive massive fibrosis. Cases of silicosis were recorded in people who worked longer in quarries.

Signs of respiratory symptoms, with the most common being breathlessness, were discovered. Cough was discovered to be the earliest symptom in most villagers who took part in the study (Warrel, et al, 1985).

2.2. SOUTH AFRICAN PERSPECTIVE

In South Africa, miners working in the gold mines were investigated for the exposure to silica dust. Cases and controls were identified from deaths reported to the Gold Miners Provident Fund in Johannesburg for the period January 1979 to October 1983. This was a case-control study undertaken to assess the association between lung cancer and silicosis or silica dust exposure in white South African gold miners. The results showed no overall association between lung cancer and silicosis (Hessel, 1986).

Two controls were matched to each case by year of birth (± 2 years) and by smoking (± 5 cigarettes or equivalent per day) assessed 10 years prior to death. Another study was done on a sample of 2209 white South African gold miners who started mining exposure during the 1936-43 year period. For this study miners with respiratory disorders in 1968-71 period when they were aged 45-54 were selected. The mortality follow-up was from 1968-71 to December 1986. The results showed no association between lung cancer and silicosis (Hnidzo, 1991).

A study on miners who were exposed to silica dust was conducted to estimate the risks of silicosis by cumulative exposure years. This was a cohort study of 3 330 gold miners who worked at least a year exposed to dust for a period of 15 years, with an average of 9 years.

Participants were supposed to have been exposed to a median silica level of less than Particulate Matter 1 (PM_1). About 170 cases of silicosis were determined from either death certificates or two cross-sectional radiographic surveys (Steenland, 1995).

It was discovered that the risk of silicosis was less than 1% with a cumulative exposure of under PM_1, then increasing to about 68 to 84% for the highest cumulative exposure category of more than 4 mg/m3 years. Cumulative exposure was found to be the best predictor of disease; this was followed by duration of exposure and average exposure (Steenland, 1995).

Moreover, mines that were closed and left unattended in South Africa pose a threat to human lives. Travelling from the west to the east of Johannesburg, particularly in the densely populated black areas, there is a band of gold mine tailing dams. Inhabitants living downhill tell stories of being covered in wind-blown dust for much of the year. Mining companies tend to ignore their legal responsibilities to rehabilitate, monitor and maintain these tailing (dumps). Furnisher, gardens and even food tends to be covered with a thin layer of dust (National Association of Clean Air, 1996).

In Kagiso township, Krugersdorp, residents had to seal off doors and windows with masking tape to avoid indoor pollution but dust from the nearby dumps continue to accumulate in ceilings and drift down onto household inhabitants, food and belongings. Some ceilings collapsed under the weight of accumulated dust (Ngidi, 2002).

Houses that were directly opposite the dump had up to 1.9 kg of dust per square meter of ceiling (National Council for Occupational Health, 2002).

The area of Davidsonville is in the mining belt to the west of Roodepoort. The community experiences a level of dust similar to what would be experienced by a person working on a dump 24 hours a day. The area was first declared a non-residential site but later people were allowed to settle with nothing being done to rehabilitate the dump (Thamaga, 2003).

Any man made activity has an impact on the environment and health of public. In Gauteng, particularly at the Witwatersrand, both past and present mining activities created a legacy of continuous environmental degration and human exposure to particulates containing organic and inorganic matters. The study of airborne dust around the mining site showed that a significant portion of dusts is of respirable size. After the evaluation of data, it was then anticipated that there silicosis does appear among population living in the vicinity of the mine site (Yousefi and Voyi, 2000).

In the city of Johannesburg, air pollution in the Central Business District (CBD) is affected by wind-blown dust from mining belt. This then increases particles that are suspended in the air, Total Suspended Particulates (TSP). Dust levels, measured as PM_{10} (particulate matter smaller than 10ųg/m³), exceed the average daily guideline. Unrehabilitated mine dumps around the area makes air pollution even worse (Yousefi and Voyi, 2000).

Furthermore, previous studies show that further research on this topic should be conducted because not much work has been done.

2.3. RESEARCH FRAMEWORK

This section presents the aim and objectives of the study, statement of the problem and the research question.

2.3.1. Aim of the Study

- To investigate non-occupational exposure to Silica dust at gaMaja village, Polokwane, Limpopo Province.

2.3.2. Objectives of the Study

i) To establish if there are differences per age group of signs and symptoms related to silicosis.

ii) To establish if there are traces of silica dust in the area.

2.3.3. Statement of the Problem

Ga-Maja village is situated next to a mine that produces silicon and members of the community are exposed to the dust that comes from the mine. Usually a lot of dust is released and becomes airborne when the mine starts blasting rocks.

This silica dust when inhaled by humans can lead to disastrous health hazard. The well known such health hazard is silicosis.

To what extent people who are located near the mine and are not working there are at risk of this disease in gaMaja village is not known. Lack of studies conducted on people who are located near the mines and are not working at the mines, coupled with lack of legislation enforcement, prompted the study to be undertaken.

2.3.4. Research Question

To what extent does non-occupational exposure to silica affect the health of ga-Maja villagers?

CHAPTER 3

METHODOLOGY

This chapter focuses on the methodology of the study which includes study site, study design, ethical consideration, sampling, data collection data analysis and pilot testing

3.1 STUDY SITE

The study was carried out at ga-Maja village (Figure 3.1), which is situated approximately 15 kilometers south of Polokwane City in Limpopo Province. The village has got an estimated population of 2000 people, mostly semi-skilled. There are two primary schools and one secondary school with approximately six hundred learners in both primary schools and approximately four hundred and fifty in the secondary school (Lebea, 2005).

Unemployment is high and it is estimated to be approximately 75% while only 25% of the population are employed. Most of those employed are working in the private sector.

Figure 3.1 The photograph shows a section of gaMaja village. Photo: Mashele MP

3.2. STUDY DESIGN

The present study used cross-sectional study which is based on a positivist philosophy. Positivist philosophy assumes that there are social facts with an objective reality apart from the beliefs of individuals (Firestone, 1987).

Furthermore, a quantitative approach was used for this study because the topic needed to investigate whether there was exposure to silica dust at the village. Little was known about the health status of villagers and dust exposure. In quantitative research a large sample can be used resulting in a more justified claim for generalization from the results and one can investigate how changes in one variable affects changes in another variable.

3.3. ETHICAL CONSIDERATIONS

After approval by the University Ethics Review Committee, a letter was issued by the University School of Health Sciences to serve as proof that the researcher was granted permission to consult leaders at gaMaja village for data collection. The letter was accompanied by an approval from the Ethics Review Committee.

The two documents were presented to the local chief to seek permission for data collection at the village.

The following were explained to the chief:

- **Privacy or voluntary participation.**

Anybody who is willing to participate in the research must do that without being forced. The right to privacy demands that there be consent for participation. Participants must be informed of their participation prior to the study.

- **Informed consent**

A consent form is supposed to be distributed to participants (see Appendix B).

- **Harm to participants**

Participants need to be informed of any harm due to their participation in this study but fortunately there are no risk in taking part in this study.

- **Confidentiality**

Participants will be notified and assured of confidentiality. The information gathered would only be used for purpose of the study and not for personal use by the researcher.

Permission was given to continue with data collection and the researcher promised to submit the findings to the school principal once the results are available. The principal of the school will then disseminate the information.

3.4. SAMPLING

Participants were chosen using purposeful random sampling since the sample was small and participants were readily available. The method was suitable because participants were selected according to what the researcher thought was typical of the target population and was also justifiable for a small sample. Purposive Sampling also uses the available participants for inclusion in the sample. Since there was a specific purpose for a specific target population, the method was convenient and it was administratively easy and does not need any sampling frame (Firestone, 1987).

Since the village has an estimated population of about 2000 residents, the study was limited to a sample size of 200 who responded from a total 380 distributed questionnaires. The target for the study was 322 respondents.

Using the Morgan and Krejcie table (1994), the researcher was able to determine the size from that population. The table indicated different total population and recommended samples sizes for each population. For an example, a population of 100 will need a sample of 80, 2000 will need 322 and for a large population of 8000 the sample size will be 367. This method of sampling is easy to use when determining sample size.

3.5. PILOT TEST STUDY

A pilot study is a small trial that is run of all the aspects planned for use in the main enquiry. This could be used on a limited number of participants who are not part of the study before the actual study begins. It helps in obtaining certain ideas of the potential obstacles in the actual study (Strydom, 2000).

Questionnaires were first pilot-tested on a group of 20 villagers from a neighbouring village to make room for any changes and to rectify any problems with the items, assess comprehension and the ability of participants to complete. They were distributed at a nearby village, which share the same language and culture as the target village. Each questionnaire had a consent form attached to it.

3.5.1. Results of the Pilot Study

The total number of villagers who participated in the Pilot study were 20, males were thirteen (65%) and females were seven (35%). Most of the participants were unemployed and their average academic level was Grade 10. The majority of the participants (100%) were all speaking Sepedi.

3.5.2 Changes made to the questionnaire

Minor changes were made to the questionnaire. On Section B, Appendix A, Question 2 (**Sehuba**), *'gantši'* was added to *'kgafetša'* to make it more accommodative. Item 10 was completely changed from *' O sepela gannyane ge ona le bao o lekanago nabo'* to *' Ekaba o nanya go feta bao o lekanago le bona'*. This was clearer than the previous question.

3.6. DATA COLLECTION

Data pertaining to exposure to silica dust was obtained from a questionnaire developed by the World Health Organisation (WHO). The questionnaire was then translated and standardized into Sepedi (local dialect) by the University of Limpopo Translation discipline to collect quantitative data.

Important items on the questionnaire were those based on the illnesses to silicosis susceptibility, indicators of exposure susceptibility and gender. These questionnaires were distributed at the village to the first two hundred participants. Participants were made aware of their rights to voluntarily participate in the study and to withdraw anytime they feel like.

The researcher administered a total number of two hundred closed-questions questionnaires with the assistance of two students from the University of Limpopo. Minimal problems were encountered during the completion of the questionnaires. It took about an hour for participants to complete the questionnaires. Completed questionnaires were placed in two large boxes and transported to the University of Limpopo (Turfloop campus) Computer centre for data capturing. The University Statistician did data analysis.

3.7. AIR SAMPLING

Apart from questionnaires other data was collected using four Dust Deposition Gauges. These two data collection methods complemented each other to obtain an easily measured indicator of exposure for a segment of the population of gaMaja village.

Samplers were used to provide reliable data as the results reflect a true reflection of exposure to a certain air pollutant (Leaderer, et al, 1990).

A total of 4 Dust Deposition Gauges were used to collect dust samples. This type of dust collection equipment was used because they are the simplest yet effective form of dust monitors available. They rely on the passive deposition and capture of dust within a tube slot. They also suited the area, which is remote and they do not need power (Dean, et al, 1990).

Samples were collected during summer in January. Only one sample per site was taken as it was during rainy times. The gauges can also be left on the field for a long period of time and provide basic data on dust deposition and dustiness of sampling location. Any airborne dust from each of the 4 compass directions settles inside the tube (Dean, et al, 1990).

Samplers were mounted at 4 different poles (North, East, South and West) around the village at a distance of approximately 2 kilometers each. The gauges were left at the village for a period of 6 hours and were monitored every 3 hours during the day by four villagers selected to assist in data collection.

After 6 hours gauges were removed with the help of a laboratory technician. Air-borne silica dust samples from the 4 selected locations were collected, then stored in a wooden box, sealed and then transported to the University of Limpopo Chemistry Laboratory. The Samplers were then stored in a cupboard to allow them to acclimatise to laboratory conditions.

3.8 PREPARATION OF STANDARDS

An amount of 2.14 g of silicon dioxide was fused with 8 g of sodium hydroxide in a zirconium crucible at dull red heat until a clear melt was obtained. The cake was cooled and dissolved in 100 ml of 1:3 hydrochloric acid and made up to 1 liter to give 1000 ppm stock solution of silicon. About 50; 100; 150; 200 and 250 ppm working standards were prepared by appropriate dilution of the stock solution e.g. 5 ml of stock solution was pipetted into 100 ml volumetric flask and filled to the mark using distilled water.

3.9 PREPARATION OF SAMPLES

About 0.370 mg from the North, 0.335 mg from the West, 0.348 mg from the South and 0.350 mg from the East of samples were weighed and transferred quantitatively into four volumetric flasks. These were the exact amount of dust samples from each site. About 1 liter of 0.1 M NaOH was heated in a steam bath to 92 ºC. An amount of 100 ml of the heated NaOH was added to each volumetric flask.

The flasks were placed in 85 ºC ultrasonic bath for 3 hours. After 3 hours, the flasks were removed, cooled and solutions were filtered through gravity. A Varian 110 atomic absorption spectrometer was used for determination of silicon.

CHAPTER 4

FINDINGS AND DATA ANALYSIS

Literature revealed that air-borne silica dust is a health hazard. For this study data was collected with the aim of investigating potential risk factors using a cross-sectional study.

Two methods of data collection were used to obtain information. The first part is based on findings collected using questionnaires (Appendix A). The concentration and the levels of respirable dust that was collected using dust deposition gauges are presented in the second part. The discussion for both methods includes graphs and tables.

4.1 DATA OBTAINED FROM QUESTIONNAIRES

This section is based on the Research Question '**to what extent does non-occupational exposure to Silica affect the health of gaMaja villagers'**. Participants were requested to answer questions based on their health history, including tobacco smoking and whether they once worked in dusty place.

About two hundred (n=200) villagers responded to questionnaires and the questions were based on silica related illnesses. Of the 200 participants, 97 were males and 103 were females.

A closer look at Table 4.1.1 shows that the majority of both male and female participants reported that they do not wheeze (81.4%) or bring up phlegm from the chest (71.4%) as compared to reported episodes of cough (48%).

Table 4.1.1 Percentages of Silica related illnesses

To what extent does non-occupational exposure to silica affect the health of gaMaja villagers	**Frequency**	
	Yes (%)	No (%)
Cough	48	52
Phlegm	28.6	71.4
Wheeze	18.6	81.4

While the categories present a fair presentation of symptoms of the villagers at gaMaja, the symptom breakdown frequency presents a clearer picture as can be seen from Figure 4.1.1.

A total number of one hundred and ninety-eight (n=198), both male and female, responded to the question 'Do you usually have cough'. About 48% (n=95) responded that they usually have cough whereas 52% (n= 103) indicated that they do not usually have cough.

For those who responded to the question 'Do you often bring up phlegm from your chest', 28.6% (n=57) said yes and 71.4% (n=142) reported not having any signs of phlegm. A total number of one hundred and ninety-nine (n=199), both male and female, responded to the question. There was one missing case.

Only 18.6% (n=37) of the respondents reported to be having a sound of wheezing from their chest. 81.4% (n=162) reported not to having any episodes of wheezing. A total number of one hundred and ninety-nine (n=199), both male and female, responded to the question on wheezing.

Respondents who reported to be smoking were 25.9% (n=51) whereas those who reported to be non-smokers were 74.1% (n=146). A total number of one hundred and ninety-seven (n=197), both male and female, responded to the question related to smoking tobacco. About 22 % (n=42) reported that they have worked in dusty place before whereas 78 %(n=149) reported never having worked in a dusty place before. A total number of one hundred and ninety-one (n=191) responded to the question on 'Did you ever work in a dusty place before'. There are nine missing cases.

Figure 4.1.1 Indicators of exposure to silicosis susceptibility

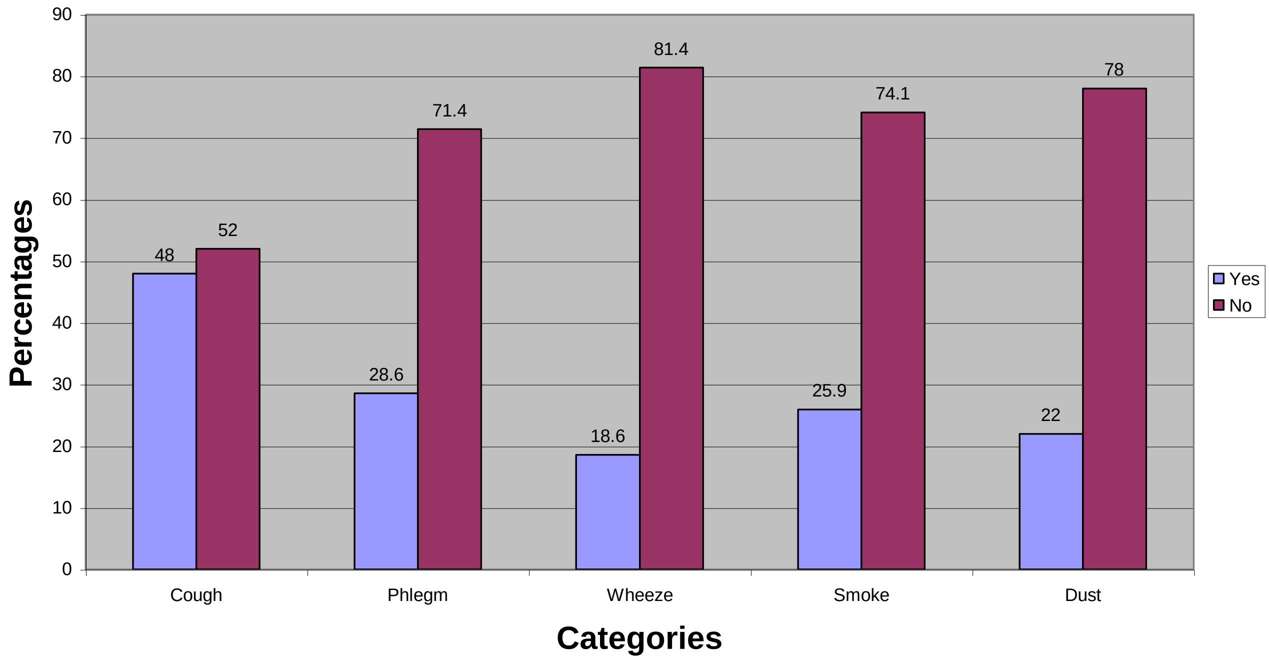


Figure 4.1.2 presents indicators of exposure to silicosis susceptibility by gender. Each question has a different number of responses with missing cases indicated.

Of the 96 male respondents, 44.8% (n= 43) reported episodes of cough and 51% (n=52) of the 102 female respondents also reported to be having episodes of cough. There were 2 missing cases.

A total of 97 males responded to the question on phlegm and 28.9 (n=28) indicated that they often bring out phlegm from their chests. About 102 females responded to the same question and 28.4% (n=29) of them reported that they also bring out phlegm from their chest. Only one case was missing.

From a total of 97 male respondents, 21.6% (n=21) indicated that they have a sound of wheeze and 15.7% (n=16) of the 102 female respondents indicated that there is a sound of wheezing from their chest. There was one missing case.

Of the total of 97 males who responded to the question about tobacco smoking, 36.1% (n=35) reported to be smokers and only 16% (n=16) of the 100 female respondents reported to be tobacco smokers. There were 3 missing cases.

Only 29.8 (n=28) from a total of 94 male respondents indicated that they once worked in a dusty place. About 14.4% (n=14) females, from 97 of those who responded to the same question reported that they once worked in a dusty place. There were 9 missing cases.

Figure 4.1.2 Indicators of Exposure to silicosis susceptibility by Gender

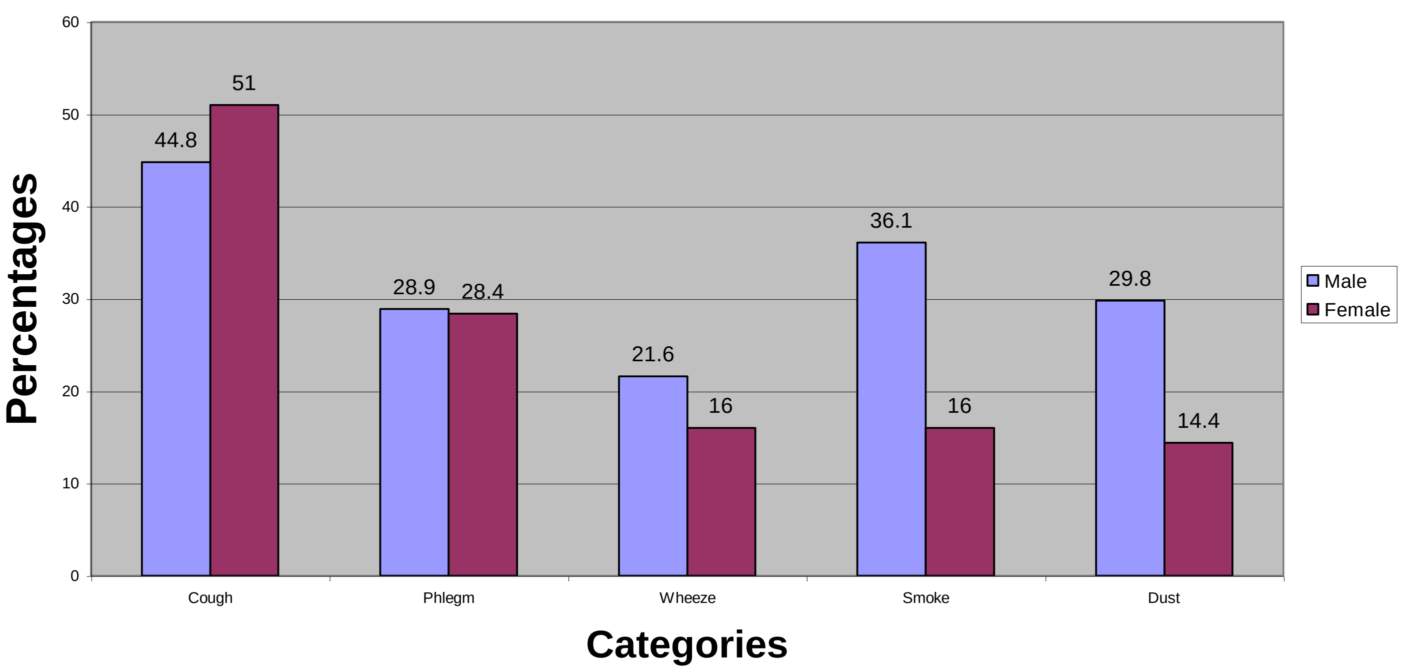
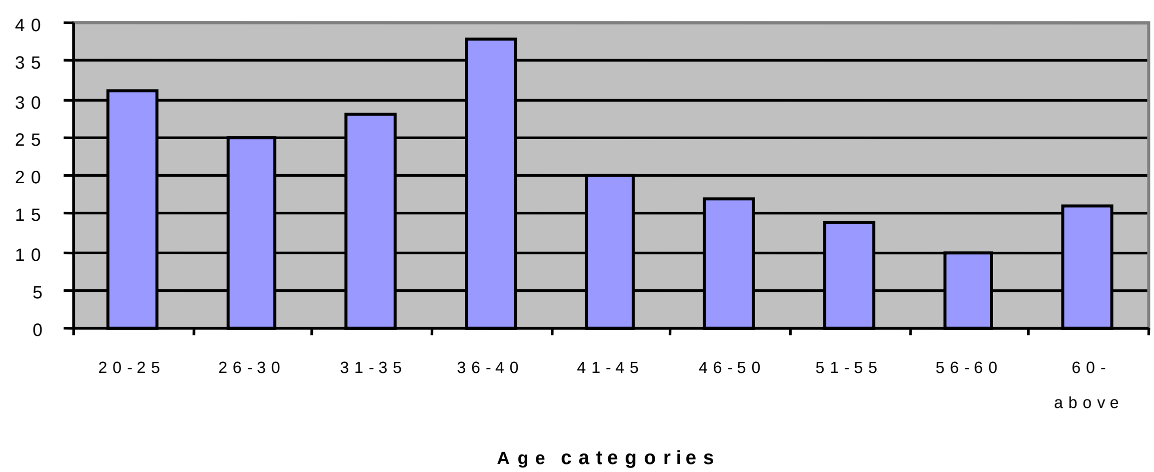


Figure 4.1.3 shows the spread of age from the 198 respondents. The majority of the respondents were from the 36 – 40 age group (n=38) and the least number of respondents were from the 51 – 55 age group (n= 14). The rest of the respondents per age group were 20 -25 (n= 31), 26 – 30 (n=25), 31- 35 (n=28), 41 – 45 (n= 20), 46 – 50 (n=16), 56 – 60 (n=10) and 60 years and above (n=16).

Figure 4.1.3 shows the spread of age of respondents



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The second highest group that reported episodes of cough were the 46- 50 age group (n=16) with 62.5 % (n=10) reporting to a high percentage. The two age groups; 51 – 55 age group (n= 14) and 60 and above, reported an equal split of 50% each to episodes of cough. A total of 199 responded to the question 'Do you usually Cough' within age.

Table 4.1.2. Responses to Cough as per age group

		Do you usually cough		Total
		YES	NO	
Age	20-25	14	17	31
	26-30	7	18	25
	31-35	9	19	28

	36-40	22	16	38
	41-45	9	11	20
	46-50	10	6	16
	51-55	7	7	14
	56-60	9	1	10
	60 and above	8	8	16
Total		**95**	**103**	**198**

Table 4.1.3 shows the responses based on the question 'Do you bring out phlegm from your chest'. Within this category respondents falling within the 56 – 60 age group (n= 10) and 41 - 45 age group (n=20) reported high (40%) episodes each to bringing out phlegm from their chest as compared to the rest of the respondents.

Table 4.1.3. Responses to Phlegm as per age group

		Do you often bring up phlegm from your chest?		Total
		YES	**NO**	
Age	20-25	9	22	31
	26-30	6	19	25
	31-35	5	23	28
	36-40	12	26	38
	41-45	8	12	20
	46-50	6	11	17
	51-55	4	10	14
	56-60	4	6	10
	60 and above	3	13	16
Total		**57**	**142**	**199**

A closer look at Table 4.1.4 shows that the age group 56 – 60 (n=10) reported a high percentage (30%) of wheeze from their chest closely followed by the 46 – 50 age group (n= 17) with 29.41%. About 6.25% of the 60 and above age group (n=16) reported a sound of wheeze in their chest. The lowest percentage (4%) was reported by the 26 – 30 age group (n=25).

Table 4.1.4. Responses to Wheeze as per age group

		Is there a sound of wheezing in your chest		Total
		YES	NO	
Age	20-25	7	24	31
	26-30	1	24	25
	31-35	4	24	28
	36-40	10	28	38
	41-45	4	16	20
	46-50	5	12	17
	51-55	2	12	14
	56-60	3	7	10
	60 and above	1	15	16
Total		**37**	**162**	**199**

4.2. DATA OBTAINED FROM SAMPLERS

This section seeks to answer the questions based on some of the objectives of the study. The objectives are investigating dust concentration at the village and the villagers' level of exposure to silica dust.

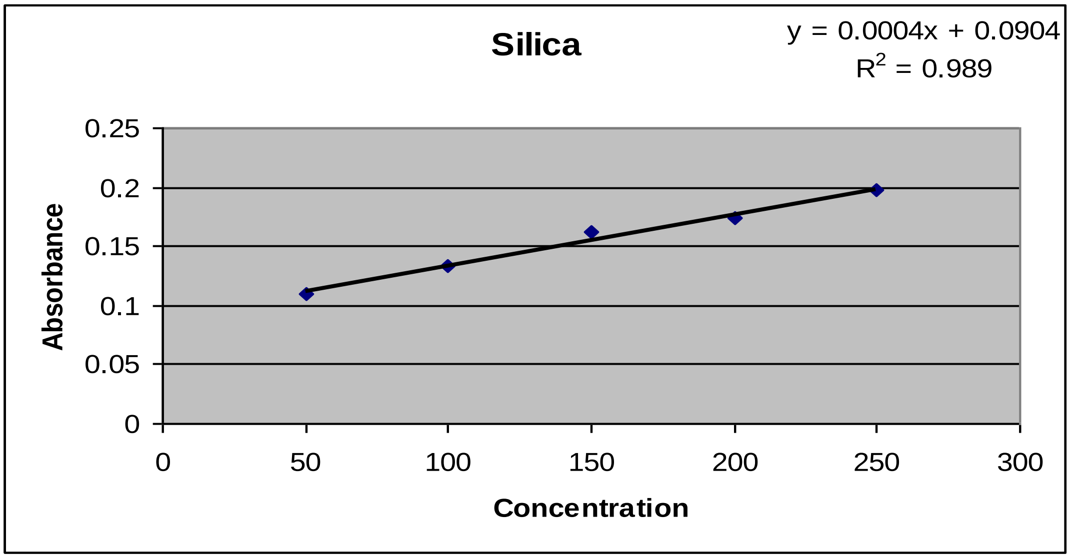
From the laboratory sample analysis the following results were found:

Table 4.2.1 Measures of absorbance of working standards and samples

Concentration	Absorbance
50 mg/l	0.1098
100 mg/l	0.1330
150 mg/l	0.1615
200 mg/l	0.1746
250 mg/l	0.1969
Sample A	0.3728
Sample B	0.3693
Sample C	0.3700
Sample D	0.3771

Table 4.2.1. shows the standard that is used for analysing data. The standard serves as a guide in determining the amount of silica in each sample (Sample A-D). These are the measures of absorbance of working standards and samples.

Figure 4.2.1 Results from atomic absorption spectrometer for the determination of silicon



From the equation of the graph, $y = 0.0004x + 0.0904$, where y represent the absorbance and x the concentration. The concentrations of the unknown samples can be calculated as follows:

1. C_A = (A – 0.0904)/0.0004 = (0.3728 - 0.0904)/0.0004 = 706.0 mg/100ml = 70.6 mg/l
2. C_B = (A – 0.0904)/0.0004 = (0.3693 - 0.0904)/0.0004 = 697.3 mg/100ml = 69.7 mg/l
3. C_C = (A – 0.0904)/0.0004 = (0.3700 – 0.0904)/0.0004 = 699.0 mg/100ml = 69.9 mg/l
4. C_D = (A – 0.0904)/0.0004 = (0.3771 – 0.0904)/0.0004 = 716.8 mg/100ml = 71.7 mg/l

CHAPTER 5

DISCUSSIONS AND RECOMMENDATIONS

5.1. DISCUSSIONS

The study evaluated villagers' exposure to silica dust during normal working hours at the silicon mine situated 2 kilometres from the village. This chapter presents a summary of the study, conclusions drawn from the findings and recommendations.

In terms of the age groups, the one stretching from 56 – 60 age group is the single one category where respondents reported the highest levels of symptoms present (Table 4.1.1). When respondents were asked about the presence of cough, wheeze sound from the chest and phlegm this age group indicated a higher level of affirmative answers compared to other age groups. This might not be surprising as people falling within the 60 and above age group, who showed fewer symptoms, might have died and were not available to participate in the study.

A total of 4 dust samples were collected from the village using dust deposition gauges and then silica dust exposure was documented.

Sampling duration was for 6 hours. After preparation of standards and preparation of samples, percentages of crystabolite in each sample were determined.

The results from dust samples that were collected reveal that there are traces of silica (crystabolite) in the village of gaMaja. Dust samples were collected during normal production at the mine in the middle of summer.

Gauges were able to identify exposure to a particular pollutant, silica dust, and were successful (Figure 4.2.1). Exposure to silica dust of respirable size is a danger to human beings. Bratvlei (2002) indicated in his study the dangers of silicosis and lung cancer for exposed human beings. Bratvlei's postulation could also apply to gaMaja village in a long run.

Most of the villagers are not aware of their exposure to silica dust and there are no measures that are taken to deal with the minimum quantity of silica dust in the area. The only measures that are put in place to prevent silica dust inhalation are at the mine but outside the mine nothing is done to safeguard non-workers.

5.2. LIMITATIONS

Limitations to this study are as follows:

- The design of this study is cross-sectional and a minimum amount of information was collected.
- Information bias by participants who might not want to disclose the symptoms, give accurate information or just wanted to get rid of questionnaires to please the researcher.
- Medical records of participants were not checked for their medical history, or other medical investigation including x-rays since silicosis exposure takes years before onset of infection (page 3).
- Sampling and data collection were not done on a full-shift and any comparison done may overestimate or underestimate the results.

5.3. RECOMMENDATIONS

Silica dust exposure was detected at the village by the 4 dust deposition gauges used. The starting point for prevention in any environment is hazard identification and then followed by risk assessment and management. Medical examination revealed that people who reside around the mines are in danger of being infected by air pollutant (Warker, 2003).

Repeated cross-sectional follow up studies could be carried out. Individuals who participated in this study might be included either from the same sample or another one. A cross-sectional study conducted in Britain for the study of Community Dentistry was carried out again over time (Levin, 2006).

A national commission, like the Leon Commission of 1995 into mine safety, is recommended to look into non-occupational exposure. Such a commission might come up with some further contributions like the Leon Commission.

Campaigns like awareness on exposure to air pollutant could also assist in educating community members about the risk of exposure to various pollutants. Most of the people believe in either witchcraft or old age as the cause of their ailments without the knowledge that there might have been other sources posing health hazards to them.

Studies like the ones conducted in Kagiso, Vaal Triangle and gaMaja need to be taken serious and continued. These studies could be conducted in partnership with government departments, private sectors, NGO's and residents in the affected areas. Further attention must also be placed on unrehabilitated mines and mine dumps like a silicon mine below (Figure 5.1).

Figure 5.1 A silicon mine, a source of silica dust. *Photo: Mashele MP*

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APPENDIX A

Re leboga go tšea karolo ga gago, se se tla thuša kudu. Araba dipotšišo ka mo o ka kgonago. Se sengwe le se sengwe se o se ngwalago ga se tlo botšwa motho o mongwe.

O belegetšwe kae __________________________

Bong

1.Monna ___

2.Mosadi___

O

1.Nyetše/nyetšwe _________

2.Mohlolo/Mohlologadi _________

3.Hladile _________

4.Ga se o nyale/nyalwe _________

Mengwaga

1. 20-25
2. 26-30
3. 31-35
4. 36-40
5. 41-45
6. 46-50
7. 51-55
8. 56-60
9. 61- go feta

A.Dika

Tše di sepelelana le mafahla/dikgara

1. Go gohlola

   Ekaba o fela o gohlola

   a) Eng

   b) Aowa

2. O gohlola go feta gane (4) ka letšatši goba go feta?

   a) Eng

   b) Aowa

3. O na le go gohlola ge o tsoga?

   a) Eng

   b) Aowa

4. O na le go gohlola bošego le mosegare

   a) Eng

   b) Aowa

B. Sehuba

1. Ekaba o ntšha sehuba ge o gohlola?

   a) Eng

   b) Aowa

2. Ekaba se se hlaga kgafetša/gantšimo bekeng?

   a) Eng

   b) Aowa

3. Ekaba se se hlaga ge o tsoga mesong?

   a) Eng

   b) Aowa

4. Ekaba se se hlaga mosegare le bošego?

   a) Eng

   b) Aowa

5. Se sena le mengwaga e me kae se hlaga?

   ____

6. Ekaba ge o gohlola go na le go lla ga mafahla/dikgara?

   a) Eng

   b) Aowa

7. Ekaba se se hlaga ntle le ge o tshwerwe ke sehuba?

   a) Eng

   b) Aowa

8. Bošego le mosegare?

   a) Eng

   b) Aowa

9. Ekaba o na le go felelwa ke moya ge o sepela?

   a) Eng

   b) Aowa

10. Ekaba o nanya go feta bao o lekanago le bona?

   a) Eng

   b) Aowa

C. Go tsuba

1. Na ekaba o tsuba/fola motsoko?
   a) Eng
   b) Aowa
2. Ekaba o ile wa tsuba/fola pele?
   a) Eng
   b) Aowa
3. O thomile go tsuba/fola o na le mengwaga e me kae?

4. O tlogetše neng?
   ____

5. O tsuba/fola dikwaye/sekerete tše kae ka letšatši?
   ____

6. O hlwa o hema muši wa sekerete?
   a) Eng
   b) Aowa

D. Mošomo

1. Naa o be o šoma kae pele?
   ____

2. Naa o kile wa šoma mo go nago le lerole le lentši.
   a) Eng
   b) Aowa

3. O šoma kae bjale?
   ____

<u>Re a leboga</u>

APPENDIX B

Kamogelo ya Tsebišo

Ke hlatsela gore monyakišiši, Mr. MP Kekana, o ntsebišitše ka tlhago, tshepidišo gammogo le mohola wa nyakišišo ye. Ke amogetše, badile gammogo le go kwešiša tshedimošo ye e filwego ka fa godimo malebana le nyakišišo ye.

Ke a lemoga gore dipoelo tša teko ye gammogo le tshedimošo yaka yeo e lego mabapi le bong bjaka, mengwaga, ngwaga wa matswalo le ditlhaka tša mathomo tša maina aka di ka se tsibišwe ge go ngwala pego ya nyakišišo ye.

Nka , ka nako efe goba efe, ntle ga go oba molato, ka ikgogela morago mabapi le kamogelo gammogo le tsibišo yaka mo go tšeyeng karolo gaka mo nyakišišon ye. Ke bile le nako yeo e lekanego ya go botšiša dipotšišo e bile ke ikemišetša go tšea karolo mo nyakišišong ye.

Leina____ (Ka kgopelo gatiša)

Letšatši-kgwedi ________________________________

Leina la Monyakišiši ________________________________ (Ka kgopelo gatiša)

Tshaeno ya Monyakišiši ________________________________

Letšatši-kgwedi ________________________________

Nna, Mr. MP Kekana ke hlatsela gore motšeakarolo yo go bolewago ka yena ka mo godimo o tsibišitšwe ka botlalo malebana le tlhago, tshepidišo gammogo le kotsi yeo e ka bago gona mabapile nyakišišo ye.

Leina la Tlhatse* ____ (Ka kgopelo gatiša)

*Tshepidišo ya kamogelo ya tsebišo ye e hlatselwe ge fela go kgonega.

Tshaeno ya Tlhatse _______________________________________

Letšatši-Kgwedi ____

<u>Kamogelo ya Tsebišo ya molomo</u>

(Ge fela motšea-karolo a sa kgone go ngwala le go bala)

Nna, yo a ikannego, Mr MP Kekana ke baletše gammogo le go hlalosetša ka botlalo

.... , tlhago le mohola wa nyakišišo ye ke kgopetšego motšea-karolo go tšea karolo. Hlaloso yeo ke e filego e bontšhitše bohlokwa ba nyakišišo ye.

Ke tiišetša gore motšea-karolo o dumetše go tšea karolo mo nyakišišong ye.

Motšea-karolo ______________________________________ (Ka kgopelo gatiša)

Leina la monyakišiši ________________________________ (Ka kgopelo gatiša)

Tshaeno ya monyakišiši ____________________________

Letšatši-kgwedi ____________________________________

Leina la Tlhatse ___________________________________

Tshaeno ya Tlhatse ________________________________

Letšatši-kgwedi ___________________________________