CHAPTER V
SUMMARY AND CONCLUSION

Diamonds have since ages been one of the most desirable stones. But the journey of a diamond from its formation below the earth surface to the final product is indeed a long one. Although the basic chemical composition of coal and diamond are the same i.e. both are made of carbon, coal has a lot more impurities as compared to a diamond. Apart from the purity aspect it is the high amount of heat and pressure that makes a diamond. India was one of the first few producers of rough diamond stone in the past around the 4th century. But gradually the Indian supplies declined and places like Brazil and Kimberly became popular for their diamond mining. Gradually, Russia, Democratic Republic of the Congo and Botswana became the biggest supplier of rough diamond stones and India became the greatest supplier of finished diamonds. Ramat Gan in Israel and Antwerp in Belgium also started off with a big diamond cutting and polishing industry but could not stand strong competition from India. It is said that 9 out of 10 diamonds polished worldwide are polished in India. Apart from these places diamond cutting and polishing is also done in China, United States, South Africa and Russia. In India, Surat city of Gujarat is the hub of diamond cutting and polishing Industry. Although there are a few industries in Mumbai and some other places in Southern India, Surat contributes 75 per cent to the entire country's production.

Mining of diamonds takes place under the earth’s crust and many times deep below the sea beds. It is the most difficult task in which geologists first search for prospective areas where rough stone can be found. Technology plays an important role in identifying such locations in which satellite imagery, ground penetrating radar and other advanced tools are employed. Open pits are created in places where stones are located close to the surface and underground mining is done where they are deep below the earth’s crust. Miners extract the ore and bring them to the surface after which it is transported to the processing plants. The ore is in a very raw form and often may have a lot of surrounding material stuck to the rough stone. This unwanted material is first separated from the stone. Once the diamond is separated from the ore, they are sorted based on size, shape, color and quality. The next step is a more technical step where these rough stones are sent for cutting and polishing. In the

cutting process the stone is first examined with the help of computer softwares and marked to ensure the best possible cut. After marking they are sent for cutting which earlier was a manual process but now laser cutting techniques are being used. Once the stones have been cut they are handed over to the polishing unit to give them the final finish. In the polishing unit each stone is rubbed against a rotating metal wheel and the different facets of the diamond are polished. The stone passes through a five step process in the polishing unit namely the table work, girdle rounding, talia work, athpel work and mathala work. This process enhances the brilliance and marketability of the stone. There are many different shapes of a diamond however the most common one is the 58 facet round brilliant cut diamond. The final shine of the finished stone depends on the experience and skills of the workers.

One of the many reasons for the diamond industry to flourish in India and specifically in Surat is the availability of cheap and skilled labourers. The industry that had the Saurashtra Patel as its integral part gradually attracted those looking for better opportunities from other states like Bihar, Madhya Pradesh, Rajasthan etc. There are many thousands of workers involved in this industry, but apart from a few big players most of this sector is still small and unorganised.

Although this industry is one of the least polluting industries, long working hours along with repetitive motions, awkward postures and uncomfortable seats may expose the workers to various problems and occupational health hazards.

The problems faced by employees in the industry can be physiological in nature including chronic diseases like diabetes, heart conditions, liver and kidney disorders etc. It may also include respiratory problems, musculoskeletal problems as well as problems related to skin, eye and ear and other eating and sleeping disorders. Apart from this the workers also face psychosocial problems which include social factors like interpersonal relationships at work, leadership etc. and also problems related to different aspects of work organisation like mental and physical stress. Problems related to the work environment like temperature, noise and facilities also contribute to psychosocial problems faced by the employees.

Apart from the problems there are certain occupational health hazards that are a part of the workplace. Ergonomic hazards are a very common danger that the workers are usually exposed to due to improper seats and awkward postures. Designing the seats

to ensure comfort for the workers and also training the workers to adopt proper postures can go a long way in reducing this issue. Also, the physical environment conditions can impose a significant risk to the health and wellbeing of the employees. Uncomfortable temperature and humidity and sometimes inadequate lighting also puts a lot of strain on the physiological as well as the psychosocial wellbeing of the workers.

While reviewing the past literature, the researcher came across many studies that are done on the physiological and psychosocial problems faced by industry workers. There were many studies conducted on the occupational health hazards as well, that workers are exposed to in their workplace. But these studies were conducted mostly in industries like the construction, textiles and iron and steel industry. There were some studies conducted in the diamond industry but they were focussed on the financial aspects, stress level of workers and addiction to tobacco. Since there was not much work done on the problems, occupational hazards, coping strategies and comfort enhancing products for the diamond polishing workers employed in the small units of Surat city, this research was undertaken. Thus, the researcher was interested to study these aspects under the umbrella of Family and Community Sciences (Home Science).

The focus of the researcher was to study the background of the diamond polishers and get information about their age, gender, family information, whether they are migrants from other places and also get information related to their work like the number of years in the industry, the type of work done etc. The physiological and psychosocial problems as well as the occupational hazards faced by the workers were also assessed and based on the findings, coping strategies were suggested to them. Comfort enhancing products were also developed for the workers to reduce the negative impact of ergonomic hazards. The present study will be very beneficial to the Department of Family and Community Resource Management as it will guide the students to study similar problems and hazards faced by workers in other small scale and unorganized industries in India. Coping strategies and comfort enhancing products may also be used in other industries with similar circumstances and requirements.

The study will be a valuable resource for researchers and academicians who are interested in studying occupational environment and problems faced by industry workers.

The study will also be of great significance for the employers as it will make them aware and provide them suggestions to make the work environment conducive for its workers.

The study will also hold great value for the workers as it will provide them with suggestions and coping strategies to make their work life better and improve their quality of mental and physiological health.

STATEMENT OF THE PROBLEM

The present study aimed to assess occupational health hazards and problems faced by the workers employed in the small diamond polishing industry. The study also aimed to suggest coping strategies and develop comfort enhancing products in order to enhance the mental and physical health of the workers.

OBJECTIVES

1. To find out the background information of the workers employed in the diamond polishing industry.
2. To assess the problems faced by the workers at their workplace.
3. To analyse occupational health hazards faced by them at work.
4. To suggest coping strategies in order to deal with their problems and enhance the mental and physical health of the workers.
5. To develop comfort enhancing products to reduce physical health hazards of diamond industry workers.

DELIMITATIONS OF THE STUDY

1. The study was limited to the diamond industry located in Surat city only.
2. The study was limited to the diamond polishing process only.
3. The study was limited to small units employing less than 50 employees.
4. The study was limited to units polishing brilliant cut diamonds only.
5. The study was limited to a sample size of 500 respondents.
6. The study was limited to those respondents who have been doing the present work for a minimum period of 2 years.

HYPOTHESES OF THE STUDY

1. There exists a relationship between Physiological Problems and Psychosocial Problems.
2. There exists a relationship between Physiological Problems and Perceived Musculoskeletal Pain.
3. The Physiological Problems of the respondents will vary with their Personal Variables (Gender, Age, Marital Status and Education Level), Family Related Variables (Family Type and Number of Members in the Family) and Work Related Variables (Work Experience and Work Type).
4. The Psychosocial Problems of the respondents will vary with their Personal Variables (Gender, Age, Marital Status and Education Level), Family Related Variables (Family Type and Number of Members in the Family) and Work Related Variables (Work Experience and Work Type).

METHODOLOGY

For the present study, a descriptive research design was used. A sample size of 100 diamond polishers from each of the five diamond polishing activity namely, 'tablework', 'girdle rounding work', 'talia work', athpel work' and 'mathala work',was selected purposively making the total sample to be 500 respondents. The units from which they were selected were small units with 50 or less workers. A total of 15 such small units were selected using the snowball technique. Data was gathered through a structured interview schedule and observation sheet. The interview was conducted in Hindi and Gujarati language. The interview schedule was divided into three sections. Section I dealt with the background information of the respondents, including their personal details, family details and work related details. Section II studied the problems faced by the employees by further sub dividing it into physiological and psychosocial problems. For the physiological problems they had to answer on a 2 point scale in terms of 'yes' and 'no', while for the psychosocial problems the 2 point scale was answered in terms of 'agree' and 'disagree'. Section III dealt with assessing the occupational health hazards experienced by the workers. Under this section the ergonomic hazard was first assessed by studying the perceived musculoskeletal pain experienced by the respondents. For this purpose a Nordic Body Map was used. The tool had 4 categories namely 'no pain', 'moderate pain', 'pain'

and ‘very painful’, to analyse the degree of pain experienced in 28 different locations of the body. From amongst the workers experiencing greater muscular skeletal related problems, 50 respondents were selected, 10 from each of the five activities. Rapid Upper Limb Assessment (RULA) was conducted in order to understand the postural load requirement of job tasks on neck, trunk and upper extremities while performing the different activities. Another occupational hazard that was analysed was the physical work environment conditions. For this purpose, various instruments were used namely the Digital Thermo Hygrometer to measure temperature and humidity, Digital Lux meter to measure the lighting levels and Digital Noise meter to measure the level of noise in the workplace. The readings were then compared with the recommended and permissible levels.

Finally, the data obtained from the interview schedule and observation sheet was tabulated and statistical analysis was conducted. Based on the analysis, coping strategies were suggested to the workers to deal with their problems and also comfort enhancing products were developed and suggested to the employers and workers. Feedback on the efficacy of the products to provide comfort was taken from the users.

MAJOR FINDINGS OF THE STUDY

The major findings of the study are presented below:

Section I: Background Information of the Respondents

Data regarding the personal information of the respondents revealed that the largest percentage i.e. 47.4 per cent of them belonged to the age group of 22-33 years. The mean age being 35.28 years. It was observed that 89.6 per cent of the respondents were male workers and very less percentage were female. Information regarding their marital status showed that 83 per cent of them were married and data collected on their education level revealed that 67.2 per cent had received education upto middle school. It was computed that 62 per cent of the workers lived in urban areas. More than half the respondents, 61 per cent lived in rented houses. Out of the 500 respondents, 185 of them had a migration history with 37.8 per cent of them moving from rural to urban areas. The main reason for migrating given by 44.3 per cent of the respondents was due to the desire to earn more.

Family related information revealed that 59.4 per cent of the respondents stayed with their family. Most of the respondents i.e. 60.2 per cent of them stayed in joint families. It was calculated that 44.2 per cent of the respondents had 4-6 members in their family and 48 per cent of the workers had 1-2 earning members in their family. Out of all the respondents only 16.8 per cent of them had other members of their family also working in the diamond polishing industry.

Data was also collected regarding their work which revealed that for 55.6 per cent of the respondents the present job was their first job. Data revealed that 42.6 per cent of the respondents had an experience of 2-10 years in the industry while 46.6 per cent of the respondents had been working in the present workplace for 2-6 years. Many of the respondents i.e. 63.8 per cent of them had got their present job through reference.

Section II: Problems Experienced by the Respondents

The physiological and psychosocial problems were assessed in this section.

Under the section of physiological problems, hypertension, allergic to pollution, weakness and tired eyes were some of the most commonly faced problems by the respondents.

The psychosocial problems included three aspects, namely, social factors at work, work organisation and work environment. The data in this section revealed that poor communication with their co-workers, work hours are not being flexible, feeling frustrated, work being monotonous, inadequate ventilation, uncomfortable temperature, irritating noise and uncomfortable seats were some of the major problems reported by the polishers

Section III: Occupational Health Hazards

Ergonomic hazards and physical environmental hazards were assessed in this section.

In order to assess the perceived musculoskeletal pain experienced at 28 main locations of the body, a Nordic Map was used. On calculating the weighted mean score for the data obtained it was observed that the major pain points were ‘back’, ‘buttock’, ‘bottom’ and ‘left shoulder’. Pain experienced by the respondents doing the five different activities were also analyzed separately and it was observed that workers doing the ‘mathala work’ and ‘table work’ experienced the highest level of pain in different locations of the body while those involved in ‘girdle rounding’ did not

experience much pain as compared to others. Thus it was seen that majority of the respondents belonged to the medium and high risk category.

Apart from the Nordic Body Map, RULA analysis was also used for 50 selected respondents to understand the postural load requirement of job tasks on the neck, trunk and upper extremities. It was observed that the level of risk experienced by 50 per cent of the respondents was so high (level 5-6) that further investigation and change was suggested for them.

To assess the physical environment of the polishing units, the indoor lighting levels, temperature, humidity and noise were analyzed. For the level of lighting it was observed that general lighting levels at the machine in 3 units was less than that recommended. The average noise level was 87.33 db which was within the permissible noise levels. The mean indoor temperature was 31.02℃ and mean humidity level was 39.33 per cent.

Section IV Testing of Hypotheses

The coefficient of correlation was found to be significant between physiological and psychosocial problems. Hence it was concluded that there exists a relationship between the physiological problems and psychosocial problems faced by the respondents.

The coefficient of correlation was found to be significant between physiological and perceived musculoskeletal pain. Hence the null hypothesis was rejected, and it was concluded that there exists a relationship between the physiological problems and perceived musculoskeletal pain experienced by the respondents.

To check whether the physiological problems and psychosocial problems of the respondents vary with age, gender, marital status, education level, family type, number of family members, work experience and work type, Kruskal wallis H Test was computed.

The test results indicated that the physiological problems vary with all the variables namely, age, marital status, education level, family type, number of family members, work experience and work type, except for gender. Dunn's Multiple Comparison Test, which is a post hoc test, was done for further analysis. It was observed that there was a significant difference in the physiological problems experienced across all age groups and education level groups. However, there was a difference between the

physiological problems experienced by respondents with 4-6 family members and more than 6 family members. The test further indicated that the physiological problems varied for all comparison groups except between the respondents with 20-28 years work experience and 29-37 years' work experience. For the work type, it was observed that the problems experienced by the respondents belonging to girdle rounding work was significantly different from the respondents doing the other four activities.

On computing the Kruskal Wallis test to analyze the variation of psychosocial problems of the respondents, it was observed that the problems vary with gender, family type and work type. Dunn's Multiple Comparison Test results further indicated that the psychosocial problems were significantly different for all worktype comparison groups except for mathala work and talia bottom work.

Section V Coping strategies to deal with physical and mental problems

Based on the personal observation and the data collected on the problems experienced by the respondents a number of coping strategies were suggested to the diamond polishers like taking rest breaks and doing simple exercises in between. Staying hydrated so that alertness and energy is maintained throughout the day. Giving emphasis to eating healthy and nutritious food and restraining oneself from addiction like alcoholism, smoking or consumption of tobacco. Incorporating meditation techniques will also prove to be beneficial. During work, adopting appropriate postures and using suitable personal protective equipment to protect from work hazards will make a significant positive contribution towards the workers physical and mental health. Above all, maintaining a positive attitude and seeking help from colleagues and employers will also contribute towards a better work experience for diamond polishers.

Section VI Development of Comfort Enhancing Products

In order to reduce the physical problems and ergonomic risks that the workers are facing, comfort enhancing products were developed and suggested to the workers.

Since it was observed that the workers doing the table work were experiencing back problems due to poor posture, an ergonomically designed low seat was developed for them.

For the workers who were sitting on stools without backrest, a special seat with backrest was designed that can be attached to any type of stool. This product not only enhances the comfort due to a cushioned seat but would also provide adequate backrest to the workers thus helping them to adopt appropriate posture.

The workers also complained of irritating noise which was produced due to the rubbing of the stone on a high speed metal wheel. Thus ear muffs were suggested to them so that the shrieking noise can be muffled down to some extent and may not lead to irritation or headaches.

The polishers who were involved with the talia, athpel and mathala work sat on stools and since there was no foot rest, they had to place their feet in an uncomfortable way which was leading to pain in the foot and calf muscles. Thus a footrest was provided to them which helped them to position their feet properly thus providing it with the much needed support.

Lastly, the workers also complained of tired eyes. And so to create awareness amongst them and train them, an eye exercise poster was developed. This poster was placed in the units with the permission of the owner and the workers were guided to follow the simple and quick exercises that they could do after atleast 3 hours of continuous work or whenever required.

Feedback of the products was taken from the workers after a period of 7 days and it was observed that most of them felt positive changes after using them.

CONCLUSION

The diamond industry of Surat runs on trust that has been developed over several decades. Though it is widely known to be a non-polluting industry, the work involved in polishing diamond requires repetitive movements while sitting in a static position and also by adopting awkward postures. It was thus observed that the workers of the diamond polishing industry experienced various problems and also faced occupational health hazards. Many of the polishers attributed their workplace to chronic diseases like diabetes, hypertension, heart diseases, cholesterol issues and kidney problems that they had developed over the years working in the industry. Certain respiratory problems like allergies to pollution, shortness of breath, chest tightness, chronic cough, loss of smell, frequent infections and asthma and musculoskeletal problems like fatigue, numbness in legs, joint pain, numbness in fingers, weakness, bent back,

swollen legs, numbness in left hand, pain in gripping, numbness in right hand were also complained by the respondents. Apart from these tired eyes, eye irritation, insomnia, severe headache, tendency to overeat, problem in seeing far objects, watery eyes, ear irritation, ear pulsation, itchy skin, loss of taste, not feeling hungry, problem seeing near object, hearing loss and skin rashes were some other problems that were reported. The respondents also reported certain psychosocial problems related to the social environment of the workplace like poor communication with their co-workers, work hours not being flexible, addiction to tobacco and poor relations with co-workers. Some work organisation related problems were that they felt frustrated, found the work to be monotonous, complained of not receiving enough job specific training and also thought that the workplace lacked good facilities. Work environment related problems faced by them included the place having inadequate ventilation, uncomfortable temperature, irritating noise and uncomfortable seats. Apart from the above mentioned problems, the occupational health hazards were also assessed. In which perceived musculoskeletal pain and postural load requirement of job tasks were assessed. It was observed that respondents involved with mathala work, talia work, athpel work and table work experienced postural problems and those involved in rounding of girdle experienced the least amount of pain. When analysing the environmental hazards it was observed that the temperature was slightly uncomfortable. Although the noise was within the permissible limits, it was quite irritating to the ears. The lighting conditions were also adequate except in a few units in which the employer must take care of the problem.

IMPLICATIONS OF THE STUDY

- **For the Academicians, Students and Researchers**

  The study will help in fostering awareness among academicians, students and researchers regarding the physiological and psychosocial problems faced by industrial workers due to the nature of their work and workplace environment.

  It will also make them aware about the occupational health hazards including ergonomic hazards and physical hazards faced by people working in the industries/factories.

- **For Industry/Organization**

  The study will make the workers and their employers aware about the physical and mental problems present in the work environment so that they are better equipped to handle the hazards.

  The coping strategies suggested by the researcher will help the polishers to reduce the impact or even prevent the physical and mental problems faced by them at their workplace.

  Comfort enhancing products developed by the researcher will prove to be very beneficial not only to diamond polishing workers but also workers employed in industries with similar work demands and situations. The products will aid in reducing physical damages and thus will contribute towards reduced mental stress and increased productivity.

  The study will aid in evaluating the occupational hazards and will also assess the significance of ergonomics in work organizations and industries to ensure a suitable workplace for the employees to enhance their productivity.

- **For the Community**

  The study will contribute towards maintaining proper physical as well as mental health of the workers.

  It will be helpful for the government, NGOs, and other bodies to explore more on the problems faced and working conditions of the workers.

RECOMMENDATIONS FOR FUTURE STUDY

1. A study of similar nature can be conducted on a larger sample size.
2. A similar study can be conducted for the diamond cutting unit.
3. A study can be conducted to assess other hazards present in the industry.
4. A study can be conducted for larger diamond cutting and polishing units.
5. A study can be conducted in an industry that polishes different shapes of diamonds.