CHAPTER III

METHODOLOGY

The chapter offers insights on the different facets of the researcher's investigative plan. The problem, the research design, and the study's variables are all discussed in detail here. Operational definitions and development of tools to aid in acquiring pertinent data have also been discussed. Protocols for data gathering and statistically analysing it are also part of this chapter. The main aim of the present research was to study the profile of the workers working in the small diamond polishing sector and assess the problems and occupational hazards faced by them. After understanding the scenario, the researcher aimed to propose coping strategies for the unit owner as well as the workers to deal with workplace hazards. The researcher also developed comfort enhancing products to help the workers deal with workplace ergonomic hazards faced by them.

To accomplish the goals of the current study, a detailed work plan and technique used is presented in this chapter under the following sub-headings:

3.1. Research Design
3.2. Variables
3.3. Conceptual Framework
3.4. Operational Definitions
3.5. Locale of the Study
3.6. Unit of Enquiry
3.7. Sample Size and Sampling Procedure
3.8. Selection of Tool
3.9. Description and Development of the Tool
3.10. Establishment of Content Validity of the Tool
3.11. Establishment of Reliability of the Tool
3.12. Data Collection Method
3.13. Data Analysis
3.14. Coping Strategies for Unit Owners and Workers
3.15. Development of Comfort Enhancing Products
3.16. Feedback regarding Comfort Enhancing Products

3.1 Research Design

A research design also called the research strategy is a technique or a plan to get answers to a set of questions. The methods, processes and procedures used to collect, evaluate and interpret the data is included in the overall structure and framework of a research design. Thus a research design is one that describes the ways that the researcher adopts in order to work through and investigate the chief problem of the research [(41)]. For the present study a descriptive research design was found to be appropriate as data regarding the background information of diamond polishers as well as environmental conditions like noise, temperature, light as well as ergonomical problems experienced by the respondents were to be collected. Descriptive research design is also used to gather information related to the physiological and psychosocial problems faced by the workers. A descriptive research design is widely used to get answers to 'what', 'where', 'when' and 'how' questions but not 'why' questions as it does not explain causal relationships. It aims at describing a population or a phenomenon in the most accurate and systematic manner. In this type of research, the researcher has no control over the variables and only observes and measures them [(42)].

3.2 Variables

The term variable implies anything that varies and takes on different values. It can be defined in terms of measurable factors that convert difficult concepts to easily understood concepts (Kaur, 2013). For the study, two sets of variables namely the independent variable and the dependent variables were identified.

3.2.1 Independent Variable:

Independent variables are those that are antecedent to the dependent variables that are the consequent (Kaur, 2013).

For the present study the data related to independent variable was collected under three sections:

- **Personal variables of the respondents-** Personal variables for the respondents included age, gender, marital status and their education level.

- **Family related variables of the respondents-** Family related variables of the respondents included the family type and number of family members.
- **Work related variables of the respondents-** Work related variables of the respondents included their work experience and work type.

3.2.2 Dependent Variables:

Dependent variables are affected by the independent variables. Manipulation in active independent variables can bring about changes in the dependent variable (Kaur, 2013).

For the present study the dependent variables were:

- **Physiological Problems-** Physiological problems included chronic diseases, respiratory problems, musculoskeletal problems and other problems related to ear, eye, skin etc.
- **Psychosocial Problems-** Psychosocial problems included problems related to the social environment at the workplace, work organization and work environment.
- **Perceived Musculoskeletal Pain-** Perceived musculoskeletal pain included the muscle pain experienced in different locations of the body by the respondents while doing the diamond polishing activity.

3.2.3 Hypothetical Relationship between Variables:

The schematic diagram given below shows the hypothetical relationship between the selected independent and dependent variables.

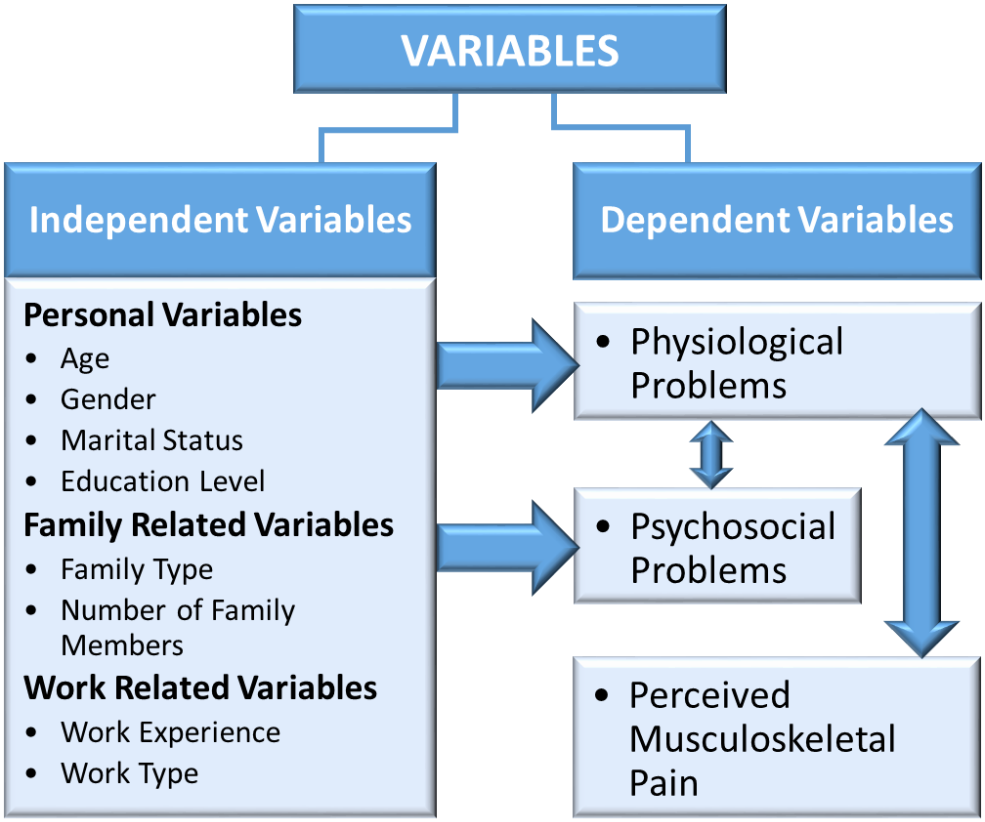


Plate 14: Schematic Presentation of Hypothetical Relationship between the Variables

3.3 Conceptual Framework

The conceptual framework of a study shows the relationship between variables and it also depicts how the research objectives fit together to provide logical findings. For the present study it was theorized that physiological problems and psychosocial problems were related to each other and the physiological problems also had a relationship with musculoskeletal pain experienced by the respondents. It was also theorized that the problems suffered by the respondents namely the physiological and psychosocial problems varied with independent variables viz. personal variables such as age, gender, marital status, education level; family related variables such as family type, number of family members and work related variables like work type and work experience.

3.4 Operational Definitions:

The operational definitions considered in the study are discussed here:

1. Diamond Polishers - For the present study diamond polishers are the ones who are involved in the polishing of the different facets of the diamonds.
2. Table Work - For the present study it was operationally defined as the first process in diamond polishing that involves polishing the single top facet of a diamond.
3. Girdle Rounding - It was operationally defined as the second process of diamond polishing that involves rounding and finishing the broadest part of a brilliant cut diamond.
4. Talia work - It was operationally defined as the third process of diamond polishing that involves polishing the bottom 24 facets of a brilliant cut diamond.
5. Athpel work - It was defined as the fourth process of diamond polishing that involves polishing the top 8 facets of a brilliant cut diamond.
6. Mathala Work - For the present study it was operationally defined as the fifth process of diamond polishing that involves polishing the 24 facets in the crown area of a brilliant cut diamond.
7. Problems - For the present study it was defined as the physiological and psychosocial issues faced by the workers due to their work and workplace environment.

a. Physiological Problems - For the present study it was operationally defined as disorders or illness occurring due to malfunctioning of the body's normal mechanisms. It includes chronic diseases, respiratory problems, musculoskeletal problems and other problems related to skin, eye, ear etc.
   i) Chronic diseases - It was defined as those health conditions that last for atleast 1 year and may impair the daily living of the individual. It may sometimes require continuous medical attention.
   ii) Respiratory problems - It was defined as those problems related to disorders of the airways, lungs and other parts of the respiratory system. It affects the normal human respiration system.

iii) Musculoskeletal problems - It was defined as a health condition in which the musculoskeletal structure of the individual is impacted resulting in continuous or recurring pain.

iv) For the present study problems related to skin, ear, eye, sleep etc. were categorised as 'Other Problems'.

b. Psychosocial problems - It was operationally defined as social conditions that have a negative impact on a person's mental health. Psychosocial problems may arise due to social factors at work, work organisation and work environment [43].

i) Social factors at work - It was defined as the problems faced due to poor interpersonal relations that exist between the employee, their colleagues and their employer.

ii) Work organization - It was defined as the problems related to different aspects of work design like work demands, role clarity, job security, work hours, work schedule etc.

iii) Work environment - It was defined as the problems related to the physical environmental hazards that cause discomfort due to extremes of temperature, excessive noise, space issues, poor lighting, quality of air and problems with equipment etc.

8. Occupational health hazards - For the present study it was operationally defined as workplace hazards that may be caused due to poor ergonomics or physical environment of the workplace.

a. Ergonomic hazards - It was defined as risks of injury due to an uncomfortable physical work environment like improper body posture for prolonged periods or lack of proper furniture.

b. Physical Environment hazards - For the present study physical environment hazards include inappropriate temperature, humidity, noise and light at the workplace.

9. Coping strategies - For the present study it was operationally defined as ways to overcome or deal with a situation or any problem in order to minimize or tolerate stress and conflict.

3.5 Locale of the Study

The locale of the study was the Varachha area of Surat which is a hub for the diamond cutting and polishing industry.

3.6 Unit of Enquiry

For the present study the unit of enquiry were the workers who were employed in the polishing section of the small diamond industry of Surat.

3.7 Sample Size and Sampling Procedure

Polishing units operating with 50 or less workers were selected using snowball technique. Snowball sampling technique is a non-probability method that is used when the desired sample characteristic is very rare and thus subjects are identified based on referrals received from initial subjects (Singh et.al., 2007). From the 15 selected units, 500 workers were interviewed.

The polishing of rough stones consists of five activities and thus, 100 respondents from each of the activities namely table work, girdle rounding work, athpel work, mathala work and talia work were selected through the purposive sampling technique. The respondents selected were those who were regular to work and had minimum two years of experience in the polishing industry. Out of the 500 respondents, 50 respondents (10 from each of the 5 diamond polishing process) were further selected using the purposive sampling technique. A detailed inquiry into the ergonomic hazard faced by them was made and based on the results, comfort enhancing products were suggested.

The chief objective of the purposive sampling method was to emphasis on certain characteristics of the population that would be instrumental in providing answers to the research questions raised in the study. Purposive sampling is a non-probability sampling technique that is used when the selection of the sample is left to the judgement of the researchers. The researcher tries to obtain the best representative sample and also saves time and money (Black, 2010). The benefit of using purposive sampling technique is that it gives researchers the rationale to infer generalisations from the investigated sample (Rai & Thapa, 2015).

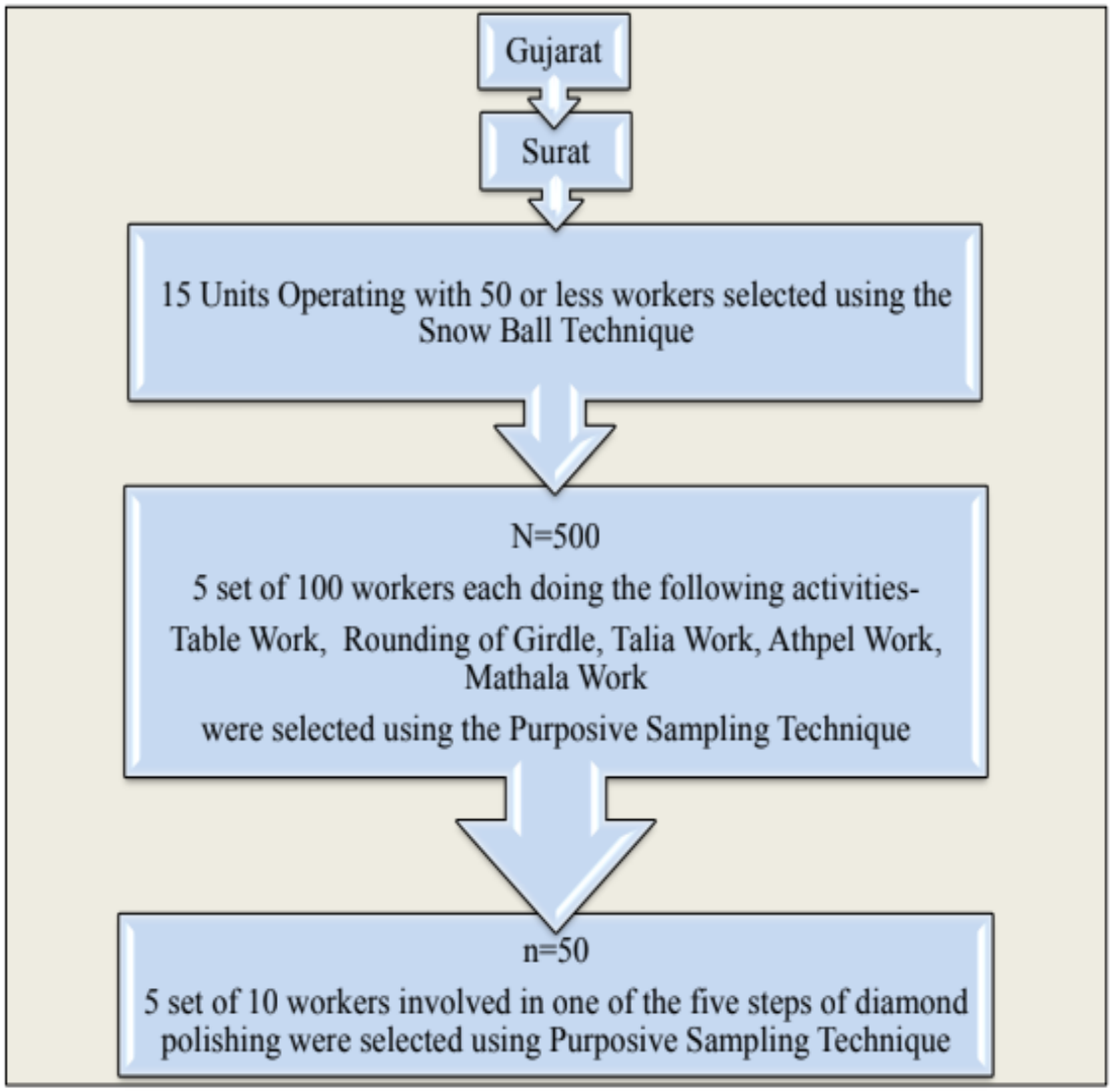


Plate 15: Schematic Presentation of Sample and Locale Selection

3.8 Selection of Tool

For the present research the Structured Interview and Observation Sheet was selected as a tool. A thorough review of literature aided the researcher to develop the tool. While developing the questions utmost care was taken to include those queries and questions that would help in collecting information that was needed to attain the objectives of the study. The tool was first made in English and then translated in vernacular languages - Gujarati and Hindi.

For the present study, the interview schedule was used for collecting background information of the diamond polishers, problems experienced by them related to physiological as well as psychosocial aspects and occupational health hazards faced by them related to ergonomic risks. The

structured interview schedule was chosen as the most appropriate tool for this present study for the following reasons:

- To overcome the limitation of the respondents ability to read and write
- To ensure uniformity in stimulus which in turn will ensure reliability
- To obtain all the necessary background information
- To get full responses from the participants
- To prevent blank entries
- To clarify any doubts that the respondents may have

The observation sheet was used for recording the physical environment hazards in the workplace as well as postural load requirements of job tasks.

Suitable instruments were used to record the temperature, humidity, lighting and noise levels of the diamond polishing units. The results helped in understanding the physical environmental hazards that the respondents were exposed to.

RULA Scale (Rapid Upper Limb Assessment Scale) was used to determine the postural load requirements of job tasks on the neck, trunk and upper extremities.

Along with the interview method, observation sheet was used to collect data due to the following reasons:

- To ensure the acquisition of reliable data and to eliminate bias.
- To facilitate quick data collection because the respondents lacked formal education.
- To focus on the information necessary for analysis

3.9 Description and Development of the Tool

Based on the objectives of the study, a suitable interview schedule as well as observation sheet was developed that comprised of the following:

The structured interview and observation sheet comprised of three sections

Section I: Background Information

Section II: Problems Faced by Workers

Section III: Occupational Health Hazards

Section I: Background Information

A- Personal Information: This part aimed at collecting the personal information of the respondents such as the age, gender, marital status, education level, location of stay, type of house, migration history and reason for migration.

B- Family Related Information: This part collected information specifically about the family of the respondents in which data related to the respondents residing status, family type, number of family members, number of earning members and employment status of family members in the diamond polishing industry was generated.

C- Work Related Information: In the third part of section I, details about the respondents work was collected, namely, their work experience, number of years employed in the current workplace, source of getting the present job and work type.

Section II- Problems Faced by the Workers

A: Physiological Problems: This part of the interview schedule, aimed to elicit information on the physiological problems experienced during the last 1 year that the workers feel can be due to the present nature of work. Data related to chronic diseases like hypertension, high cholesterol, kidney problems, heart diseases and diabetes was collected. Data related to respiratory problems like tendency to contract frequent infections, allergies, trouble in smelling, chest tightness, chronic cough, shortness of breath, asthma and others was collected. Data related to musculoskeletal problems like weakness, fatigue, swelling of legs, numbness in legs, hands and fingers, pain in gripping, bent back, etc was collected. And data about other problems like those related to eye, ear and skin along with headaches, loss of taste, insomnia, tendency to eat less or overeat was also collected from the respondents.

B: Psychosocial Problems: This part of the interview schedule, aimed to gather information on the psychosocial problems experienced by the diamond polishers at their workplace which impacts their work. Data was collected on the problems related to social factors at work like their relationship with their employer, co-workers, communication issues etc. Data related to work organisation like work

pressure, monotony at work, rest breaks etc. was collected. Psychosocial problems related to the work environment were also studied. Under this section data related to suitability of equipment, temperature, light, ventilation, seats etc. was collected.

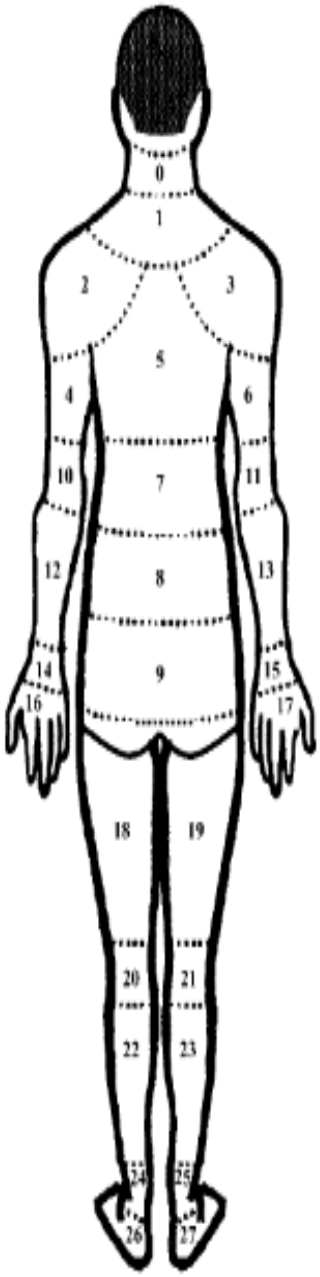
Section III- Occupational Health Hazards

Under this section the ergonomic hazards and physical environment hazards were studied using the interview technique and observation sheet.

A: Ergonomic Hazard

a. Perceived Musculoskeletal Pain: In order to study the perceived musculoskeletal pain experienced by the workers in the diamond polishing industry, the Nordic Body Map (NBM) was used. Nordic Body Map assesses the musculoskeletal problems occurring due to non-ergonomic work postures. It helps in determining the extent to which pain is experienced in 28 different locations of the body encompassing major areas like neck, shoulders, upper back, elbows, wrist/hands, low back, hips/thigh, knees and ankles/feet. Scores are to be assigned on a four-point scale with 'no pain' (1 point), 'moderate pain' (2 point), 'pain' (3 point) and 'very painful' (4 point). The individual total score defines the degree of risk associated with it and also proposes the level of improvement required for the same.

   Individual score range of 28-49 is categorised under 'low risk which doesn't need improvement'. Score ranging from 50-70 comes under 'medium risk which may need improvement'. Score range of 71-91 is associated with a 'high degree of risk which needs improvement' and a score between 92-112 is categorised as a 'very high degree of risk which needs improvement as soon as possible'.



No	Location	Grade of complaints			
0	Pain/stiff in the upper neck	A	B	C	D
1	Pain in the lower neck				
2	Pain in the left shoulder				
3	Pain in the right shoulder				
4	Pain in the left upper arm				
5	Pain in the back				
6	Pain in the right upper arm				
7	Pain in the waist				
8	Pain in the buttock				
9	Pain in the bottom				
10	Pain in the left elbow				
11	Pain in the right elbow				
12	Pain in the left lower arm				
13	Pain in the right lower arm				
14	Pain in the left wrist				
15	Pain in the right wrist				
16	Pain in the left hand				
17	Pain in the right hand				
18	Pain in the left thigh				
19	Pain in the right thigh				
20	Pain in the left knee				
21	Pain in the right knee				
22	Pain in the left calf				
23	Pain in the right calf				
24	Pain in the left ankle				
25	Pain in the right ankle				
26	Pain in the left foot				
27	Pain in the right foot				

Plate 16: Nordic Body Map

b. Postural Load Requirement of Job Tasks: Out of the 500 respondents, 50 respondents in total from the five step process of diamond polishing were selected and RULA scale was used to assess the postural load requirement of job tasks on the neck, trunk and upper extremities. RULA was developed by Dr. Lynn McAtamney and Professor E N Corlett in 1993, as a survey method to carry out ergonomics studies in workplaces where work related upper limb problems are reported. This instrument provides a quick method of evaluating the postures of neck, trunk and upper limbs as well as it considers the external load received by the body. No specific equipment is required for this assessment. The action list reflecting the degree of involvement necessary to lower the risks of injury due to physical loading on the operator is generated using a coding system. The different positions of body segments are observed and noted individually. More the deviation from neutral position, greater is the risk of developing musculoskeletal diseases. The final scores calculated individually helps in determining whether any change in the postures is desired or not. A score of 1-2 indicates that the 'posture is acceptable'. While a score of 3-4 states 'further investigation and change may be needed'. The score of 5-6 indicates that 'further investigation and change soon' is desired while the score of 7 and above states 'investigation and implementation of change' is needed.

RULA Employee Assessment Worksheet

Task Name: Date:

A. Arm and Wrist Analysis

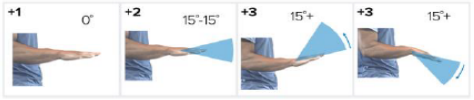
Step 1: Locate Upper Arm Position:

Step 1a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

Step 2: Locate Lower Arm Position:

Step 2a: Adjust...
If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:



Step 3a: Adjust...
If wrist is bent from midline: Add +1

Step 4: Wrist Twist:
If wrist is twisted in mid-range: +1
If wrist is at or near end of range: +2

Step 5: Look-up Posture Score in Table A:
Using values from steps 1-4 above, locate score in Table A

Step 6: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Step 7: Add Force/Load Score
If load < 4.4 lbs. (intermittent): +0
If load 4.4 to 22 lbs. (intermittent): +1
If load 4.4 to 22 lbs. (static or repeated): +2
If more than 22 lbs. or repeated or shocks: +3

Step 8: Find Row in Table C
Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in **Table C**.

Upper Arm Score

Lower Arm Score

Wrist Twist Score

Wrist Score

Posture Score A

\+

Muscle Use Score

\+

Force / Load Score

=

Wrist & Arm Score

Scores

Table A

Upper Arm	Lower Arm	Wrist Score 1 Wrist Twist 1	1 2	Wrist Score 2 Wrist Twist 1	2	Wrist Score 3 Wrist Twist 1	2	Wrist Score 4 Wrist Twist 1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

Table C

Wrist / Arm Score	Neck, Trunk, Leg Score 1	2	3	4	5	6	7+
1	1	2	3	3	4	5	5
2	2	2	3	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	4	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7

Scoring (final score from Table C)
1-2 = acceptable posture
3-4 = further investigation, change may be needed
5-6 = further investigation, change soon
7 = investigate and implement change

RULA Score

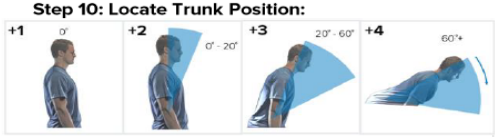
B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position:

Neck Score

Step 9a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Step 10: Locate Trunk Position:



Trunk Score

Step 10a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Step 11: Legs:
If legs and feet are supported: +1
If not: +2

Leg Score

Table B: Trunk Posture Score

Neck Posture Score	1 Legs 1	1 Legs 2	2 Legs 1	2 Legs 2	3 Legs 1	3 Legs 2	4 Legs 1	4 Legs 2	5 Legs 1	5 Legs 2	6 Legs 1	6 Legs 2
1	1	3	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	4	5	5	6	7	7	7	
3	3	3	3	4	4	5	5	6	6	7	7	7
4	5	5	5	6	6	7	7	7	7	8	8	
5	7	7	7	7	7	8	8	8	8	8	8	
6	8	8	8	8	8	8	8	9	9	9	9	

Step 12: Look-up Posture Score in Table B:
Using values from steps 9-11 above, locate score in Table B

Step 13: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Step 14: Add Force/Load Score
If load < 4.4 lbs. (intermittent): +0
If load 4.4 to 22 lbs. (intermittent): +1
If load 4.4 to 22 lbs. (static or repeated): +2
If more than 22 lbs. or repeated or shocks: +3

Step 15: Find Column in Table C
Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find Column in **Table C**.

Posture B Score

\+

Muscle Use Score

\+

Force / Load Score

=

Neck, Trunk, Leg Score

based on RULA: a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99

Plate 17: Rapid Upper Limb Assessment Scale

B: Physical Environment Hazard

This part focussed on deriving the information regarding the environment of the workplace including existing temperature (^{o}C), humidity level (%), noise (dB) and indoor lighting level (lux),. The specifications of the instruments used to get the data have been given below:

a. Indoor Outdoor Thermometer with Hygrometer - the instrument was used to measure indoor temperature and humidity levels in the diamond polishing units.

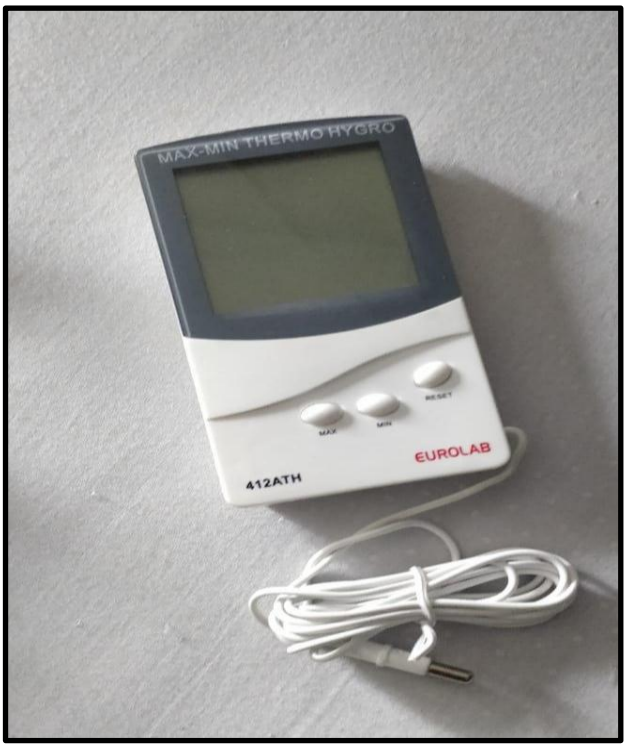


Plate 18: Indoor Outdoor Thermometer with Hygrometer

Instrument specifications:

- Model: 412ATH
- Name: Indoor Outdoor Thermometer with Hygrometer
- In-Range: 0^{o}C to 50^{o}C (32^{o}F to 122^{o}F)
- Out- Range: -40^{o}C to 70^{o}C (-40^{o}F to 158^{o} F) ^{o}C ← → ^{o}F exchangeable
- Accuracy: ± 1^{o}C RH ± 5% Indoor-hygro range: 25% RH to 90% RH
- Features: 1.5 meter sensor wire. One 1.5 Volt AA battery.

b. Digital Noise Meter- the instrument was used to measure noise levels inside the diamond polishing units.

Plate 19: Digital Noise meter

Instrument Specifications

- Model: SL4001
- Function: dB (A and C frequency weighting),
  Time weighting (Fast=200 ms/ Slow=500ms)
  Max. hold, AC and DC output
- Display: liquid Crystal display, 3.5 digits
- Measurements: 3 ranges, 35 dB to 130 dB
- Accuracy: 23 ± 5^{o}C, Calibrating input signal on 94 dB (31.5 Hz to 8000 Hz).
- Frequency: 31.5 Hz to 8,000 Hz
- Microphone: electric condenser microphone, ½ inch standard size
- Range selector: 30 to 80 dB, 50 to 100 dB, 80 to 130 dB, 50 dB on each step, with over and under range indicating
- Operating temperature: 0^{o}C to 50^{o}C (32^{o} F to 122^{o} F).

c. Digital Lux Meter- the instrument was used to measure indoor light level of the diamond polishing units.

Plate 20: Digital Lux Meter

Instrument Specifications

- Name: Digital Battery Operated Lux meter
- Range: 0 – 50000 Lux
- Sr. No: L-753831

3.10 Establishment of Content Validity of the Tool

Assessing an instrument's content validity determines whether it adequately captures each pertinent aspect of the concept it seeks to assess. The interview cum observation scale was first carefully constructed and then sent to a panel of eleven judges having expertise in the field of Family and Community Resource Management and Ergonomics. The panel was requested to overview the clarity of the tool and also check its relevance to the objectives of the present study. It was pre decided that for including any statement in the tool, 80 per cent consensus of the judges would be considered. After the review, there were no changes required in the tool as suggested by the panel of judges.

3.11 Establishment of Reliability of the Tool

In the present tool, two scales were developed. The first scale was developed to assess the physiological problems and the other to assess the psychosocial problems. The split half method was used to establish the reliability of the scales. The reliability value was found to be high for the scales.

Table 2: Overview of the scales with reliability value

Sr. No.	Scales	Reliability Value
1	Physiological Problems	0.82
2	Psychosocial Problems	0.79

3.12 Data Collection Method

The data was collected between the months of September, 2022 to January, 2023. The researcher approached 24 small scale diamond polishing units. Out of these only 15 agreed to cooperate and allow the researcher to carry the study. Interview cum observation sheet was used to collect the data. Before beginning, the researcher briefed the respondents regarding the purpose of carrying out this survey. They were encouraged to voluntarily participate in the study as this would be beneficial for their wellbeing. They were also given the assurance that confidentiality and anonymity would be maintained and the information collected would be used for research purposes only. The responses were collected on a pre-validated structured interview schedule. The respondents enthusiastically participated and cooperated in giving responses.

The researcher used the Indoor Outdoor Thermometer with Hygrometer, Digital Noise Meter and Digital Lux Meter to collect data regarding the environment in the observation sheet. Pictures and videos were taken of the respondents doing the polishing activities in order to conduct RULA analysis.

During the entire process of data collection, the researcher faced some difficulty from a few industries and a few respondents as they were hesitant to share information. The respondents and owners of the units were thanked by the researcher for lending their support and participating in the survey.

3.13 Data Analysis:

Categorization, coding, tabulation, and statistical analysis using relational statistics (Coefficient of Correlation, Kruskal Wallis H Test and Dunn's Multiple Comparison Test) and descriptive statistics (frequency, percentage, mean and weighted mean) were the steps taken to analyze the acquired data.

3.13.1 Categorization

I Background Information:

It was further subdivided into 'Personal Information', 'Family Related Information' and 'Work Related Information'.

A. Personal information: categorization of the data was done based on the age, gender, marital status, education level, location of stay, type of house, migration history and reason for migration.

a. Age:
   1. 22-33 years
   2. 34-45 years
   3. 46-57 years

b. Gender:
   1. Male
   2. Female

c. Marital Status:
   1. Married
   2. Unmarried

d. Education Level:
   1. No formal education
   2. Upto middle school
   3. Upto high school

e. Location of Stay:
   1. Urban
   2. Sub-urban
   3. Rural

f. Type of house:
   1. Owned
   2. Rented

g. Migration history:
    1. Intercity (within state)
    2. Rural to urban (within state)
    3. Inter state

h. Reason for migration
    1. Better lifestyle
    2. Desire to earn more
    3. Lack of employment opportunities

B. Family Related Information: categorization was done on the basis of whether the respondents were staying with or away from their family, family type, number of family members, number of earning members and whether any other family member was employed in the diamond industry.

a. Residing Status:
    1. Residing with family
    2. Residing away from family

b. Family Type:
    1. Joint
    2. Nuclear

c. Number of family members:
    1. 1-3
    2. 4-6
    3. 6<

d. Number of earning members:
    1. 1-2
    2. 3-4
    3. 4<

e. Employment status of family members in the diamond polishing industry:
    1. Employed
    2. Not Employed

B. Work Related Information: categorization was done under work experience years, number of years in the current workplace, source of getting the present job and work type.

a. Work Experience:

1. 2-10 years
2. 11-19 years
3. 20-28 years
4. 29-37 years

b. Number of years in the current workplace:

1. 2-6 years
2. 7-12 years
3. 13-18 years

c. Source of getting the present job:

1. Self
2. Reference

d. Work Type:

1. Table work
2. Rounding of Girdle
3. Talia Work
4. Athpel Work
5. Mathala Work

II Problems Faced by the Respondents:

It was further categorized into 'physiological problems' and 'psychosocial problems'.

A. Physiological Problems: In this scale, physiological problems experienced by the respondents in the last 1 year that they attribute to their work and workplace, was assessed. The respondents were required to answer in 'yes' or 'no' to each of the given problems. Problems were categorized as: -

1. Chronic problems
2. Respiratory problems
3. Musculoskeletal problems
4. Other problems related to eye, ear, skin etc.

B. Psychosocial Problems: in this scale the respondents were supposed to answer whether they 'agree' or 'disagree' with the presence of the given psychosocial problems at the workplace. The problems were categorized as under:

1. Social factors at work
2. Work organisation
3. Work environment

III Occupational Health Hazard:

It was further divided into 'ergonomic hazard' and 'physical environment hazard'.

A. Ergonomic Hazards: in order to determine the ergonomic hazard two separate tools were used, 'Nordic Body Map' and 'Rapid Upper Limb Assessment (RULA)'.

a. The Nordic Body Map was used to assess the perceived musculoskeletal pain experienced in 28 different locations of the body. The degree of pain was determined on a scale of 1-4 in which 1 meant 'no pain', 2 meant 'rather pain', 3 meant 'pain' and 4 meant 'very painful'. The degree of risk and the improvement needed was determined based on the individual sum of scores as depicted in the table below.

Table 3: Categorization of the Degree of Risk based on Nordic Body Map Scores

Sr. No.	Individual Score	Degree of Risk	Improvement
1	28-49	Low	Does Not need improvement
2	50-70	Medium	Maybe needs improvement
3	71-91	High	Need improvement
4	92-112	Very High	Need improvement as soon as possible

b. The Rapid Upper Limb Assessment scale was used to determine the postural load requirements of job tasks on neck, trunk and upper extremities. On the basis of the assessment on the RULA scale, the individual scores of the respondents were calculated and then categorized on the basis of the following:

Table 4: Categorization of the Level of MSD Risk based on RULA Range Scores

Score	Level of MSD risk
1-2	Acceptable Posture
3-4	Further investigation, changes may be needed
5-6	Further investigation, change soon
6+	Investigate and implement change

B. Physical Environment Hazard: in order to determine the physical environment, hazard different tools were used namely, Indoor Outdoor Thermometer with Hygrometer (to calculate temperature and humidity), Digital Noise Meter (to measure the level of noise) and Digital Lux Meter (to measure level of lighting).

3.13.2 Statistical Analysis

Data was analyzed by using the following techniques:

3.13.2.1 Descriptive Statistics

For the present study frequency, percentage, arithmetic mean and weighted mean was computed in order to analyze and study the background information of the respondents and also the problems and occupational health hazards faced by them.

a. Frequency: It was used to determine the total number of responses under each category.

   Frequency = Sum of Responses (In number)

b. Percentage: It was used to determine the frequency in terms of percentage.

$$Percentage = \frac{Frequency}{Total\ number\ of\ responses}\ x\ 100$$

c. Arithmetic mean: It was calculated in order to sum up the characteristics of the whole group. It is determined by dividing the sum of all values of a data set with the total number of values.

It is represented as:

$$\underline{X} = \frac{\Sigma fX}{\Sigma f}$$

Where:

$\underline{X}$ is the Mean

f is the number of occurrences

ΣfX is the sum of products fX

Σf is the number of occurrences

d. Weighted mean: It was calculated to give a more accurate estimate of the population by allotting them different weights. It was obtained by multiplying the weight associated with an outcome with its quantitative outcome and then summing all the products together.

$$\underline{X} = \frac{\Sigma WnXn}{\Sigma Wn}$$

Where:

$\underline{X}$is the Weighted Mean

W_n is the weight of the data set

X_n is the data value

3.13.2.2 Relational Statistics

Coefficient of Correlation, Kruskal Wallis H Test and Dunn's Multiple Comparison Test (Post Hoc Test) were computed to test the hypotheses for the study.

Table 5: Relational Statistics Applied to Test the Hypotheses

Tests	Variables
Coefficient of Correlation	Physiological Problems And Psychosocial Problems
	Physiological Problems And Perceived Musculoskeletal Pain
Kruskal Wallis H Test & Dunn's Multiple Comparison Test (Post Hoc)	Age, Gender, Marital Status, Education Level, Family Type, Number of Family Members, Work Experience, Work Type with their Physiological Problems
	Age, Gender, Marital Status, Education Level, Family Type, Number of Family Members, Work Experience, Work Type with their Psychosocial Problems

3.14 Coping Strategies for Unit Owners and Workers:

Based on the observations and the results obtained from the data collected, the researcher suggested coping strategies for the polishing unit owners as well as for the workers. The strategies involved some basic changes to the workplace setup and functioning from the point of view of the owner and some lifestyle changes from the point of view of the workers.

3.15 Development of Comfort Enhancing Product:

After analyzing the present situation, researching on the existing tools available in the market and matching it with the diamond industry needs, suitable comfort enhancing products were developed and provided to selected workers to get their feedback.

Comfort enhancing products provided by the researcher are as follows:

1. Ergonomic Floor Seat
2. Detachable Padded Seat with Backrest
3. Ear Muffs
4. Foot Rest
5. Informative Poster

The participants were requested to use the products for seven days during their work hours and observe if they experienced any relief in the problems reported by them. On the 8th day their feedback regarding the same was taken.

3.16 Feedback Regarding Comfort Enhancing Products

The researcher suggested and provided comfort enhancing products to the workers of the diamond polishing units. After they had used the products for a week, feedback was taken about the products and whether the product aided in enhancing comfort during work and reducing postural discomfort.