Chapter 3
Materials and Methods

CHAPTER – 3

MATERIAL AND METHODS

Systematic methodology is an important step in any research because it directly influences the validity of the research findings. Research methodology is a systematic and scientific way to solve the research problem and in it both research method and logic behind the method are considered. The study "An Ergonomic assessment of occupational health hazards faced by health care workers of selected Hospitals adopts a detailed plan of work and sequential procedure. For sequential and systematic presentation, this chapter has been divided in the following section-

- Research design
- Theoretical framework of study
- Variables of the study
- Operational definitions
- Selection, construction and description of the tool
  - Selection of the tool
  - Construction of the tool
  - Selection of scales
- Establishment of content validity of tool
- Establishment of reliability of scale
- Selection of the sample
- Methods of data collection
- Data analysis procedure

➢ Research Design

Research design is the conceptual framework within with the research is conducted. In order to achieve the objectives of the study both the descriptive and experimental design were planned.

Descriptive research design was planned to find out the nature of work carried out by health care workers in the hospitals, nature and incidence of occupational health hazards experienced by HCW and psychological cost of work.

On the other hand experimental research design was planned to find out physiological cost of work in terms of energy expenditure, total cardiac cost of work, heart rate and postural stress while performing different activities in hospital.

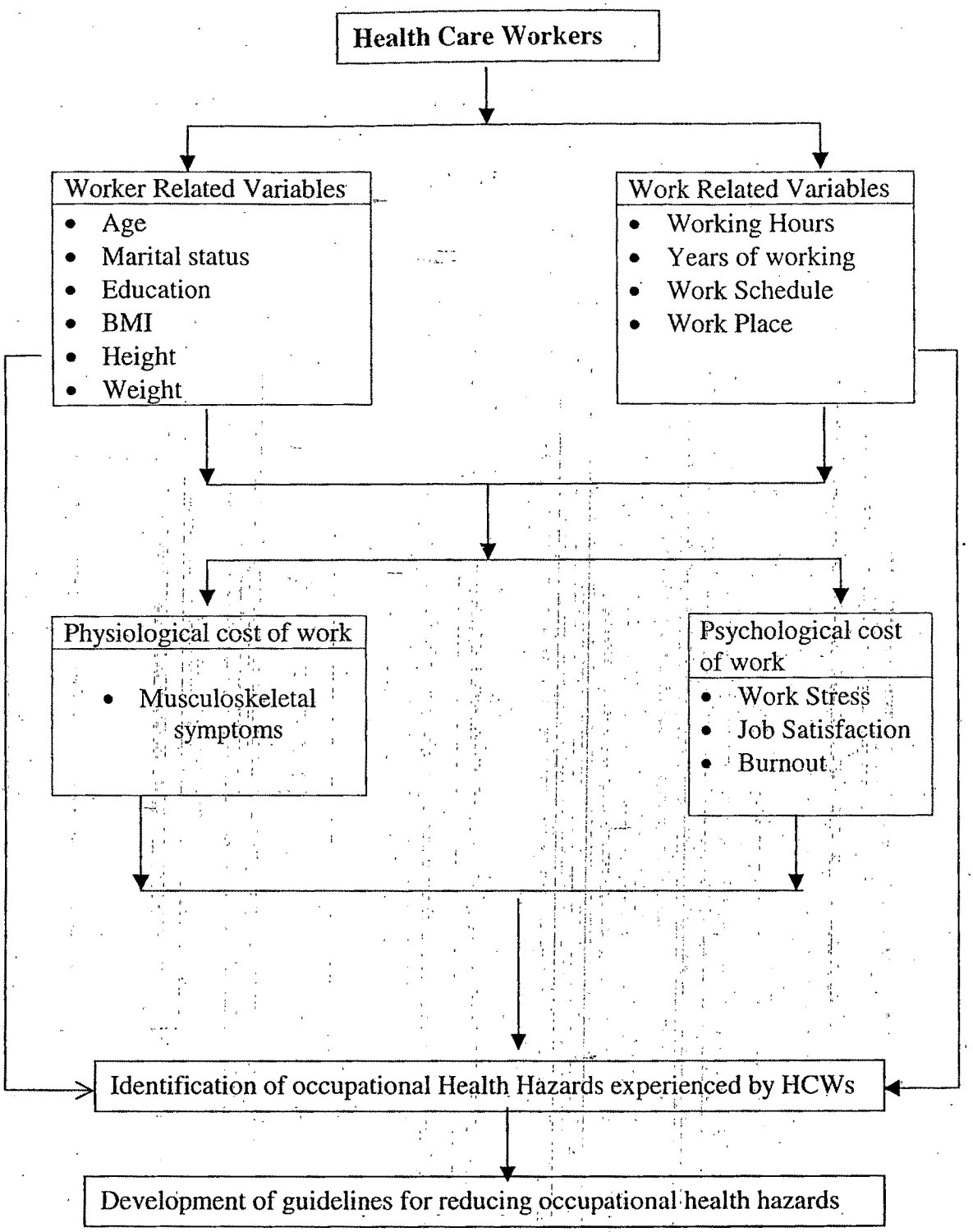
➢ Theoretical Framework of Study

Theoretical framework of the study was discussed in following two subheadings.

Theoretical Framework of descriptive Study (Fig. 3.1)

It is theorized that worker related variables i.e. age, education, body mass index, height, weight and marital status and work related variable i.e. working hours, years of working, work schedule and work place affect the working of HCWs. These working conditions affect physiological and psychological cost of work. So to reduce these stress and health hazards there is a need to identify these occupational heath hazards faced by health care workers while working in hospitals and develop guidelines to reduce occupational health hazards (fig.3.1).

Fig.3.1 Theoretical Framework of Descriptive Study



➢ **Variables of the Study**

A variable is any characteristics that varies across people or situations that can be of different levels or types. The schematic framework to show the hypothetical relationship between the variables considered for the present study is as follows:

❖ **Variables for descriptive study (Fig 3.2)**

- **Independent Variables:**

Variables that are antecedent to the dependent variables are known as independent variables. In the present study independent variables are worker related variables i.e. age, education, BMI, marital status, height, weight and work related variables i.e. years of working, working hours, work schedule, and work place.

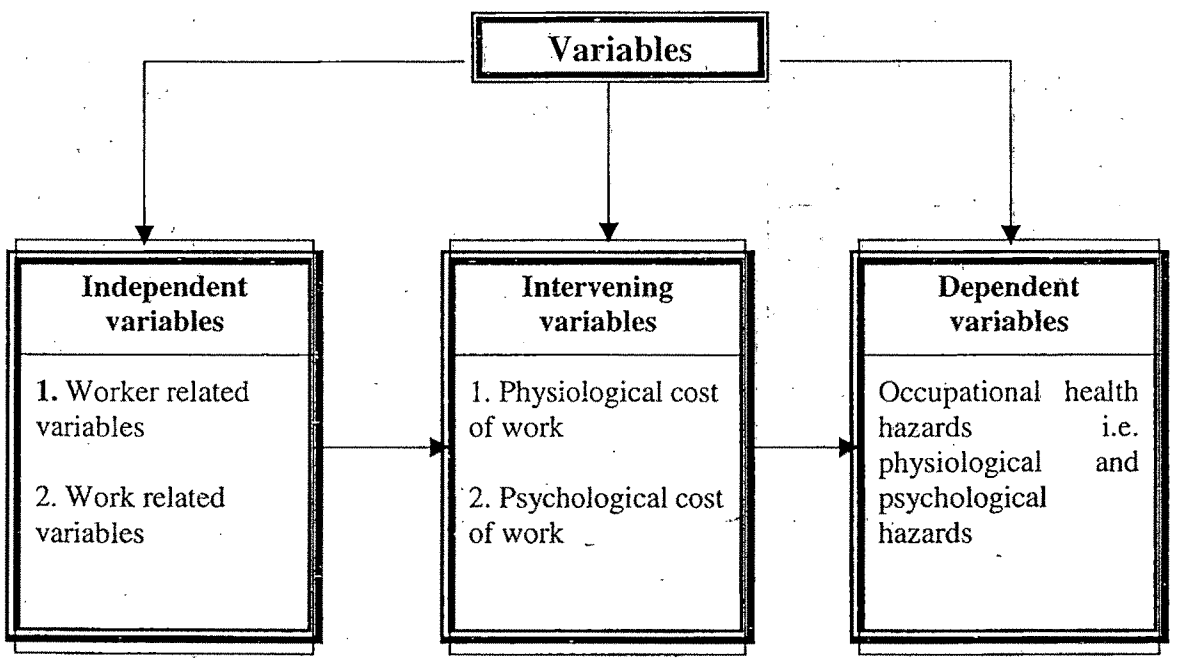


Fig 3.2 – Schematic Presentation of Variables for descriptive study

Worker related variables includes

- **Age (years):** Age seen in terms of numbers of years completed. It is an important variable causing the variability in the working performance.

- **Educational Level:** It is measurement in terms of level of formal education. Education was one of the important variables which indicate the status of HCWs in hospital and also the job rank. It influences the working strategies of HCWs, while working in hospital. It was observed that educational level also affect body discomfort/health problems experienced by HCWs. Some studies showed that higher the educational level; lower would be health problems because educated workers easily adopted improved practices of work, therefore they had less health problem (Singh and Singh1970; Patel and Singh and Borah, 1991). Hence it was thought to be appropriate to include educational level as an independent variable for the present study.

- **Marital status:** Marital status affects the individual psychologically. If the individual is married he/she has to perform dual responsibility (if he/she is working) i.e. of job as well of family and has to cope up with the demands of those responsibilities. If he/she is not able to do so it will affect the working and family life both. So, it is also considered as one of the independent variable of the present study.

- **Body Mass Index:** BMI is a relationship between weight and height that is associated with body fat and health risk.

- **Height:** Height was measured in cms from head to foot with the help of anthropometric rod. As work height has to be in relation to height of worker. This parameter was considered important.

- **Weight:** Weight was measured with the help of measuring balance in kgs. Weight of the worker also has impact on his/her performance of work and posture. Hence it was chosen as a variable.

Work related variables includes

- **Working hours:** The health and efficiency of workers depend upon the number of hours they have to work (Sharma, 1995). The working hours are of great importance to analyze the musculoskeletal problems, because the amount of time one works affects the posture and may affect the musculoskeletal structure of the human body and the psychological stress. In case of long working hours the worker is bound to be tired and slacken and may be prone to accidents and injuries.

- **Work schedule:** This includes the shifts of work that HCWs have to do. The work schedule affects their working performance and health status, because in the morning shift workers are more active as compared to their working performance in afternoon and evening.

- **Years of working**: This is also one of the most important variable. It includes the years the HCWs have done job in a hospital. This affects their working performance and their zeal to serve people and help in acquiring necessary skill in performing job.

- **Work place:** work place represents the area where HCWs works in hospital i.e. surgery ward, operation theatre, medicine ward, orthopedics, etc. In different areas there is different type of work performed by HCWs.

- **Intervening Variables**

The intervening variables act as dependent variables being directly or indirectly affected by independent variables and they also operate as independent variable affecting dependent variable.

Physiological cost of work and psychological cost of work were the intervening variables for the present study. Physiological cost of work was affected musculoskeletal symptoms experienced by HCWs. Psychological cost of work includes stress due to work, job satisfaction and burnout. It was postulated that a variety of work and worker related variables have a direct impact on the physiological and psychological cost of work of HCWs.

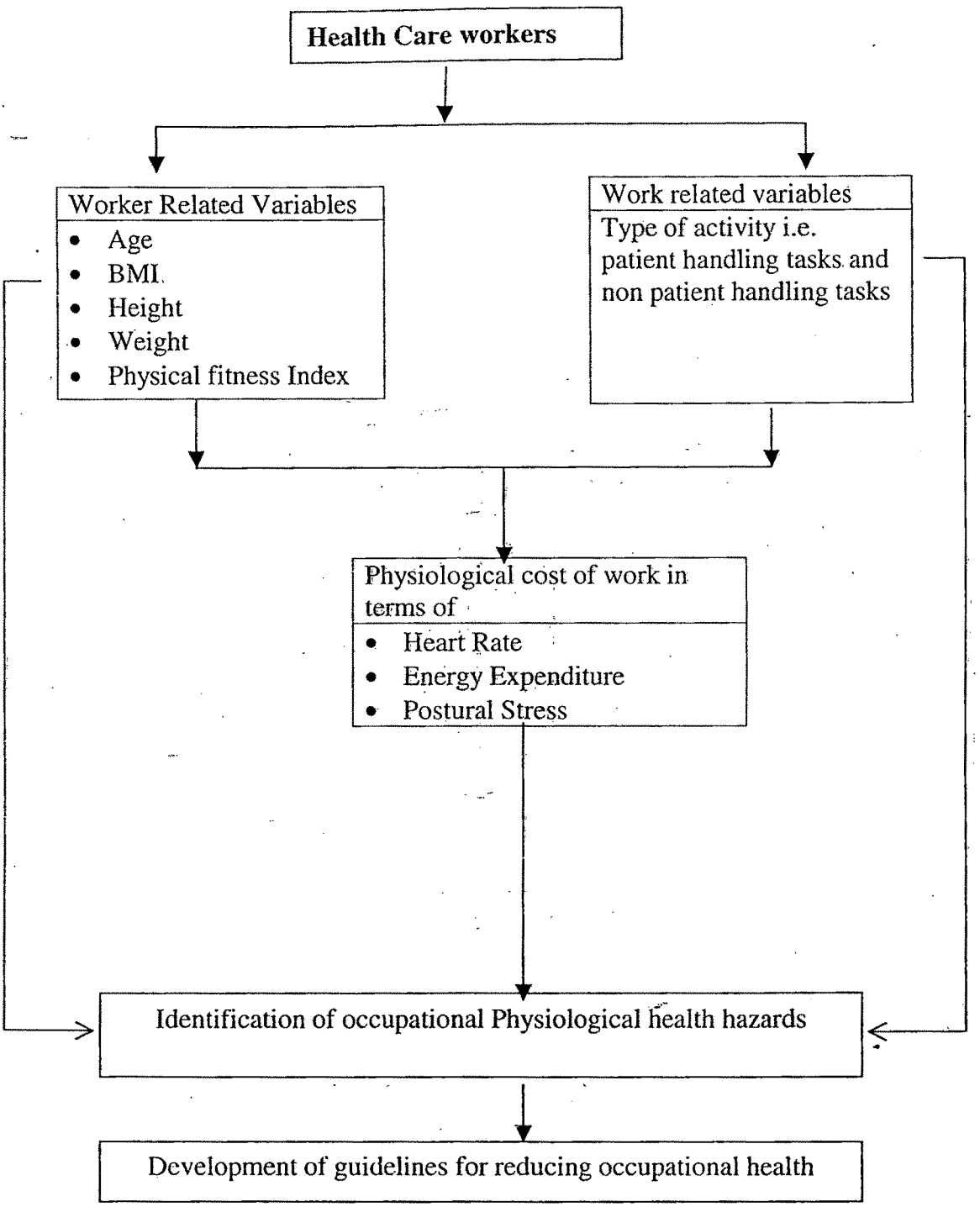
- **Dependent Variable**

Any variable dependent upon any other or is a consequence of any other variable is termed as dependent variable (Kothari, 1990). With context to this study occupational health hazards i.e. Physiological and psychological hazards was considered as the dependent variables.

Theoretical Framework of Experimental study (Fig. 3.3)

As descriptive theoretical framework, the experimental theoretical frame work also theorized that worker related variables i.e. age, sex, BMI, height, weight and physical fitness index and work related variables i.e. type of activity both patient handling tasks (PHT) and non patient handling tasks (NPHT) affect Physiological cost of work of HCWs in terms heart rate, energy expenditure postural stress, total cardiac cost of work which leads to the occupational health hazards There is a need to identify occupational physiological health hazards and develop guidelines to reduce these health hazards (Fig 3.3)

Fig.3.3 Theoretical Framework of Experimental Study



❖ **Variables for Experimental study (Fig.3.4)**

- **Independent Variables:** In the present study independent variables are worker related variables i.e. age, height, weight, BMI (Body Mass Index) and physical fitness index and work related variables i.e. type of activity (patient handling tasks and non patient handling tasks).

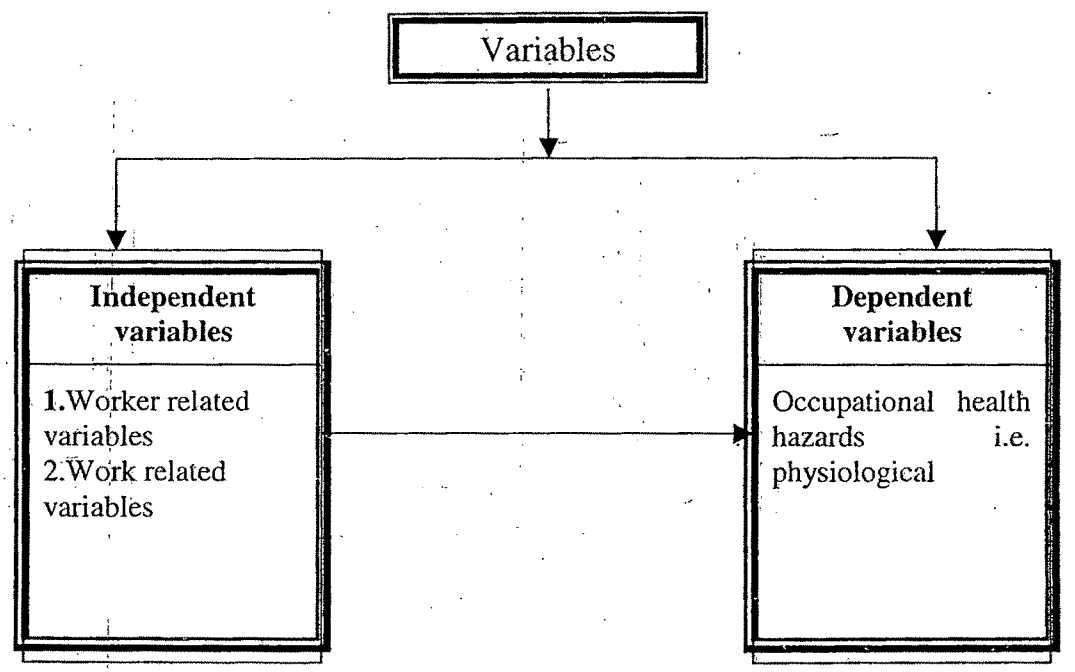


Fig 3.4 – Schematic Presentation of Variables for Experimental study

Worker related variables includes

- **Age:-** Age of the HCWs may influence their working performance and their dealing with patients, the extent to which their working pattern cause health hazards and stress while working in hospital. So age is considered as an important variable.

- **Height:** Height was measured in cms from head to foot with the help of anthropometric rod. As work height has to be in relation to height of worker. This parameter was considered important.

- **Weight:** Weight was measured with the help of measuring balance in kgs. Weight of the worker also has impact on his/her performance of work and posture. Hence it was chosen as a variable.

- **Physical Fitness Index:** Physical fitness is the state of health of the selected HCWs.

Work related variables includes

- **Type of activity**: Types of activities performed by HCWs seems to play a very important role in physiological and psychological cost of work experienced by them. This includes both patient handling activities and non-patient handling activities. In patient handling activities while dealing with patients HCWs adopts different postures which affects their health and while directly dealing with patients HCWs may suffer from various types of health hazards and diseases. Non-patient handling activities also affects health status of HCWs i.e. postural stress.

- **Dependent Variables**

In the present study occupational health hazards i.e physiological hazards experienced by HCWs are the dependent variables for the experimental study. Physiological hazards i.e physiological cost of work in terms of heart rate, energy expenditure, and postural stress.

➢ Operational Definitions

Certain terms used in the present study are operationally defined as follows

❖ **Ergonomics** – Ergonomics is operationally defined as the study of the anatomical, physiological and psychological aspect of worker in relation to his work and working equipment.

❖ **Health Care Workers (HCWs)** – Health care workers can be defined as all workers or persons working in health care delivery units such as hospitals, pharmacies etc. e.g. Nurses, ward boys laboratory technicians, pharmacists, physicians etc. In the present study HCWs include only two categories of persons working in hospitals i.e. nurses and wardboys.

❖ **Occupational health hazards** – Occupational health hazards refers to hazards, illness and injuries, which were experienced by health care workers while working in hospitals. These hazards could be broadly divided in to following categories: physiological hazards i.e. biological, chemical, physical, ergonomic factors, accidental and violence problems and psychological hazards.

❖ **Biological hazards:** Hazards of contracting communicable disease from the patients, infections due to exposure to blood, body fluids or tissue specimens. Possibly diseases from which HCWs may suffer while working in hospital are HIV, Hepatitis B & Hepatitis C.

❖ **Chemical hazards:** Hazards due to exposure to anesthetic gases, skin defatting, irritation & dermatoses because of frequent use of soaps, detergents & disinfectants etc. exposure to medications, sterilizing fluids, & latex allergy caused by exposure to natural latex gloves & other medical devices.

❖ **Physical Hazards:** Hazards due to exposure to ionizing radiations, noise, heat & cold, vibration, electric and magnetic fields.

❖ **Ergonomic factors -** Included injuries due to awkward work postures. Such as the prolonged standing, bending or kneeling.

❖ **Occupational injuries:** The injuries such as strains & sprains, followed by puncture, wounds, abrasions & contusions, lacerations, back injuries, burns and fractures which the HCWs were exposed in work place.

❖ **Occupational Illnesses:** The Illnesses includes respiratory problems, injections, and dermatitis, hepatitis and drug or medicine reactions suffered by HCWs while working in Hospital.

❖ **Types of activity:** There are various types of activities, which are involved in hospital work. Only selected activities were taken for investigation i.e. patient handling tasks and non-patient handling tasks.

❖ **Patient handling tasks (PHT):** The activities performed by HCWs in hospital in which they are in direct contact with patients like patient handling in bed, bed making, lifting a patient from lying to sitting on bed, etc

❖ **Non-patient handling tasks (NPHT):** The activities in which patients are not directly involved but the activities are performed for patients only i.e. bed making, moving equipments, etc.

❖ **Physiological cost of work:** In the present study it is seen in terms of heart rate (beats/ min), energy expenditure (KJ/min), and total cardiac cost of work, postural stress, involved in doing work.

❖ **Heart Rate:** Heart rate is defined as the number of heart beats per minute.

❖ **Measure of Energy Expenditure:** The normal heart rate & increased heart rate during performance of task are measured & then the energy expenditure is calculated with the help of following formula: -

Energy expenditure (KJ/min) = (0.159 x Av. Working heart rate beats / min) – 8.72

❖ **Posture in work:** Posture means maintaining the normal curve of the body while performing different activities. Posture in work means the whole center of gravity remains as close as possible to that of normal standing erect condition.

❖ **Physical fitness Index:** Physical fitness is the state of health of the selected HCWs it was assessed by using the following equation.

$$\text{Physical fitness Index (PFI)} - \frac{\text{Duration of exercise / sec x 100}}{\text{Sum of exercise I}^{st}, \text{II}^{nd} \text{ \& III}^{rd} \text{ Recovery pulse count}}$$

Selected HCWs ranked from poor to excellent on the basis of physical fitness :-

Up to -80	-	Poor Physical fitness
80-100	-	Low average physical fitness
101-115	-	High average physical fitness

116-135	-	Good average physical fitness
136-150	-	Very good physical fitness
Beyond 150	-	Excellent physical fitness

(Cited from AICRP Report, 2001)

❖ **Work related musculoskeletal disorders (WMSDs):** WMSDs are injuries to the soft tissues of the body, the muscles, tenders that connect muscles to bones, ligaments that connect bone to bone, nurses arteries and veins, every part of body that's not a bone or internal organ. Pain is the most common symptom of these injuries.

❖ **Body Mass Index**: A measurement of the relative percentages of fat and muscle mass in the human body, in which weight in kilograms is divided by height in centimeters and the result used as an index of obesity.

❖ **Anthropometric Measurement:** It is concerned with measurement of human body from anatomical point of view.

❖ **Psychological cost of work:** This is defined as the harmful physical and emotional responses of the worker when the requirements of job do not match his/her capabilities, resources or needs. In the present study psychological cost of work includes work stress, job satisfaction, and burnout.

❖ **Burnout**: - Burnout is a concept that may be understood as a form of psychological distress arising form overexertion of the self that manifests as a severe loss of energy and deterioration of performance based on Maslach Burnout Inventory.

❖ **Work stress:** The psychological stress experienced by HCWs due to work schedule, work environment, occupational status, work autonomy based on work stress scale

❖ **Job satisfaction:** Psychological comfort, which the HCWs experience while performing activities or while working in hospital based on job satisfaction scale.

➢ Selection, Construction and Description of tool

❖ Selection of the tool

A precoded personal interview schedule was used to collect data on general information from the HCWs pertaining to research work, due to certain reasons.

1- To ensure availability of completely filled in data sheets.
2- To safeguard against non-return of the data sheets.
3- To establish rapport in order to elicit correct response & to clarify issue.

❖ Construction of tool

The interview schedule was divided into four sections. Closed end questions were framed to gather information related to the study.

Section 1- This section was designed in order to elicit the general information of HCWs. It contained questions about the background of HCWs, about hospital and the nature of activities performed by HCWs while working in hospitals.

Section 2- This sections was again divided into three parts.

Part 1: This part was again subdivided in to two

Part 1 A-included question regarding the personal information of HCWs.

Part 1 B- this part was constructed to gather the information on medical background of HCWs.

Part 2: This part contained questions regarding occupational injuries & health hazards faced by HCWs while working in Hospital.

Part 3: This part included questions regarding musculoskeletal symptoms and disorders caused to HCWs while doing patient handling tasks and non patients handling tasks, standardized Nordic questionnaire for the analysis of musculoskeletal symptoms was also used.

Section 3: This section included various scales to find out psychological cost of work experienced by HCWs i.e. work stress scale, job satisfaction scale and Maslach burnout inventory.

Section 4: It included types of observation sheets and recording tables for recording of physiological cost of work in terms of heart rate, energy expenditure, total cardiac cost of work, postural stress, physical fitness index, body map, work surface dimensions, and anthropometric measurements.

❖ **Selection of scale:** For the present study following standardized scales are selected:

1-**Work stress scale: (Cited from Cooper, 1988)** Occupational stress is defined as the harmful physical and emotional responses of the worker, when the requirements of the job do not match his/her capabilities, resources or

needs. The major stressors, which have been documented, include time-related stressors, fearful patients, his loads, financial worries, staff problems, equipment breakdown, defective material, poor working conditions and the routine and the nature of job. (Cooper, 1980; Dunlop and Stewart, 1982: Furnham, 1983; Selor, 1984). A set of 46 statements describing potentially stressful working condition under 6 Factors i.e. Factor 1- Time Schedule pattern, Factor 2- dealing with patients Factor 3- Pay related Stress, Factor 4- Stress due to inter personal problem, Factor 5- Stress due to technical problem; Factor 6- Violence problem: The subjects were required to rate each item among 3 responses ranging from "no stress"(1), "little stress" (2) and "a great deal of stress (3).

2-Job satisfaction scale: (Murali, 1997) Satisfaction of the employee in their jobs is of paramount importance in determining the success with which any organization functions. Job satisfaction depicts the state of mind of an employee at a particular point of time, i.e. whether he is satisfied or not with his job. As satisfaction is subjective and cannot be measured, it is essential to develop a measuring tool for the job satisfaction and therefore a satisfaction scale was developed. The statements were divided under the categories of work autonomy, occupational status, work schedule and work environment as per the classification given by Burge and Culver (1989) these statements were approximately half positive and other half negative and were randomly listed. Response on these set of statements was seen on a five – point continuum to indicate level of agreements i.e. "Strongly agree"(5) "agree (4)" , "Uncertain (3)", "disagree (2)" and strongly disagree" (1).

3. Maslach burnout Inventory (MBI): The MBI was used as the measure of burnout. The questionnaire consists of 22 questions with 7 possible answers ranging from "never"(1) "a few times a year" (2), "Monthly" (3) " a few times a months" (4), "Every week" (5), "a few times a week"(6) to "everyday" (7) to assess the frequency of occurrence of the three aspects of the burnout

syndrome: - Physical exhaustion (PE), Emotional Exhaustion /Depersonalization (EE & DP), Personal Accomplishment (PA)

The PE Subscale measured feeling of being physically exhausted by one's work. . A second subscale, EE + DP, measured feeling of being emotionally over extended by one's work, and having an impersonal and unfeeling attitude towards patients. Psychologically workers feel that they are unable to continue giving of themselves because their emotional resources are depleted. As one's sense of depersonalization increases, one becomes negative, cynical and callous. In practice, depersonalization is a problem that manifests itself as deterioration in the quality of patient care, with HCWs treating patients as "objects" (Maslach and Jackson, 1981). A third subscale, PA measured feelings of competence and achievement in one's work with people.

➢ Establishment of content validity of tool

❖ Test of validity:

Validity is the most critical criterion and indicates the degree to which an instrument measures what it is supposed to measure. In other words, validity is the extent to which differences found with a measuring instrument reflect true differences among those being tested.

➢ Content validity of Interview schedule:

Content validity is the extent to which a measuring instrument provides adequate coverage, of the topic under study. Its determination is primarily judgmental and intuitive. It is determined by using a panel of judges, who judge how well the measuring instrument meets the standard.

For establishing the content validity of the tool constructed for the present study, the tool prepared initially was distributed to a panel of judges (12). They were experts from various colleges, superintendents and senior

specialists from various hospitals of district Nainital, Udham Singh Nagar and Pauri, i.e. Faculty of Home science (department of Home) Management Baroda / M.S. University of Baroda, College of Home science (Department of Family Resource Management), College of Veterinary sciences (Department of Veterinary physiology), of G.B. Pant university of Agriculture & technology, Pantnagar, superintendent and specialists of department of surgery, pediatrics, medicine and dental orthopedics, pathology and eye of R.D. Joshi memorial combined hospital Ramnagar; Base Hospital, Haldwani; Male district Hospital, Pauri and female district hospital Pauri, and chief medical officer and deputy chief medical officer, District Pauri.

Some questions were modified and added as suggested by the judges.

For this a score sheet was prepared for the judges and the screening of this was done on the basis of the following criteria.

1- Those items, selected by 70% or more judges on relevance were retained in the scale.

2- Those items which were not clears by 70% or more judge were reformed to make them clear and meaningful.

- **Establishment of reliability of the scale for the present study**

Reliability is the level of internal consistency or stability of the measuring devices. The reliability therefore refers to the test consistency. The standardized scales were tested for reliability in the context of present study.

The reliability of the Job satisfaction scale was tested with the application of Split-half technique. The zero order co-relation between even and odd numbered item was worked out as a measure of reliability. The

coefficient of reliability was computed with the help of Spearmen Brown Prophency formula (Guilford and Fresher, (1978)

$$R = \frac{(\sum xy)}{\sqrt{(\sum x)^2 X (\sum y)^2}}$$

Following equation was used to understand reliability coefficient of the scales:

$$rtt = \frac{2rtt}{1 + r\,hh}$$

were,

rtt = Reliability of total test estimated.

rhh = Correlation between half.

The correlation coefficient computed between odd and even items was 0.63 and the reliability coefficient was 0.80 for job satisfaction scale and the correlation coefficient and reliability coefficient for work stress scale was 0.68 and 0.78.

This established that the standardized scale of job satisfaction and work stress were reliable instrument for the purpose of the study.

Standardized Nordic Questionnaires for the analysis of musculoskeletal symptoms

This questionnaire was designed by the Nordic council of ministers. The questionnaires consist of structured, forced, binary or multiple-choice variants and can be used as self administered questionnaires in interviews. There were two types of questionnaires: a general questionnaire is simple surveying and specific ones focusing on the low back and neck shoulders. The general questionnaire was designed to answer the following question – "Do musculoskeletal troubles occur in a given population, and if so, in what parts of the body are they localized?" with this consideration in mind, a questionnaire

was constructed in which the human body (viewed from the back) was divided into nine anatomical regions, i.e. neck, shoulders, elbows, wrists/hands, upper back, lower back, one as both hips/thighs, one or both knees and one or both ankles/feet.

The two specific questionnaires concentrate on anatomical areas in which the musculoskeletal symptoms are most common i.e. neck, lower back and shoulder. The purpose of the general questionnaire is simple surveying while the specific ones permit a somewhat more profound analysis.

The two main purposes of the questionnaires are to serve as instruments (1) in the screening of musculoskeletal disorders in a ergonomic context & (2) for occupational health service. The present study only general questionnaire was used.

➢ Selection of the Sample

❖ Selection of the locale

The present study was carried out in 8 government hospitals having 50 or more than 50 beds of District Nainital, District Udham Singh Nagar and District Pauri of Uttaranchal state. The hospitals are

1) Jawaharlal Nehru Hospital (Udham Singh Nagar)
2) R.D. Joshi. Combined Hospital, Ramnagar (Nainital)
3) Base Hospital, Haldwani (Nainital)
4) District Female Hospital (Paruri)
5) District Male Hospital (Paruri)
6) Base Hospital, Shrinagar (Pauri)
7) Combined Hospital, Shrinagar (Pauri)
8) Combined Hospital, Kotdwar (Pauri)

❖ **Sampling Design**

The multistage, purposive cum systematic sampling design was used to select the sample. To select the region and block purposive sampling design was adopted, which involve deliberate selection of particulars units of universe for constituting a sample, based on the ease of access. From the state of Uttaranchal; District Nainital, Pauri and Udham Singh Nagar were purposively selected and from theses District all Government Hospital having 50 or more than 50 beds were selected. To select the HCWs systematic sampling design was adopted Every 2nd HCW was selected to collect sample HCWs and this was done till the desired numbers is secured. (Fig 3.6)

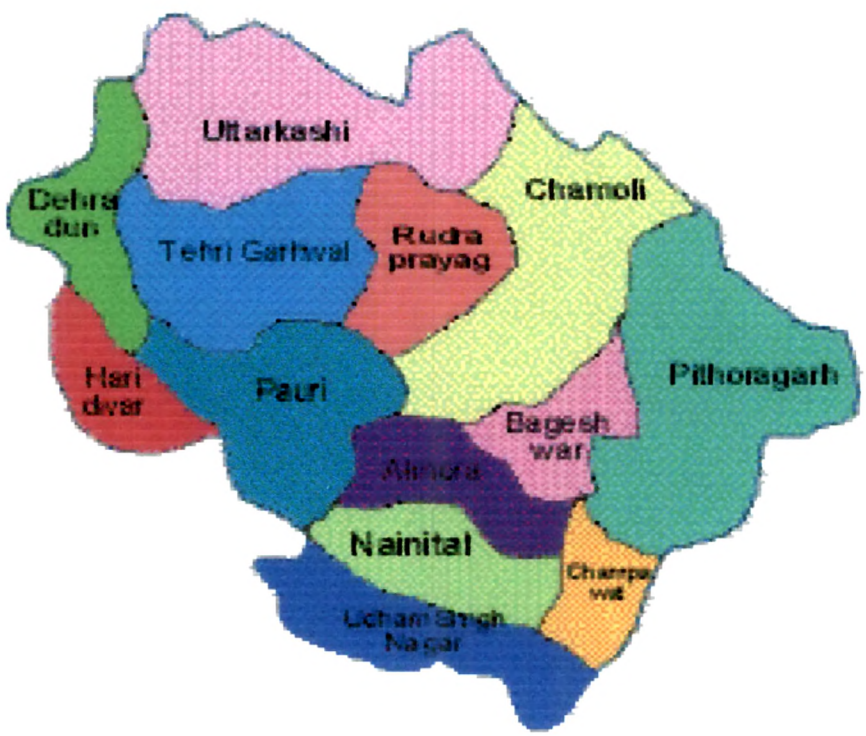
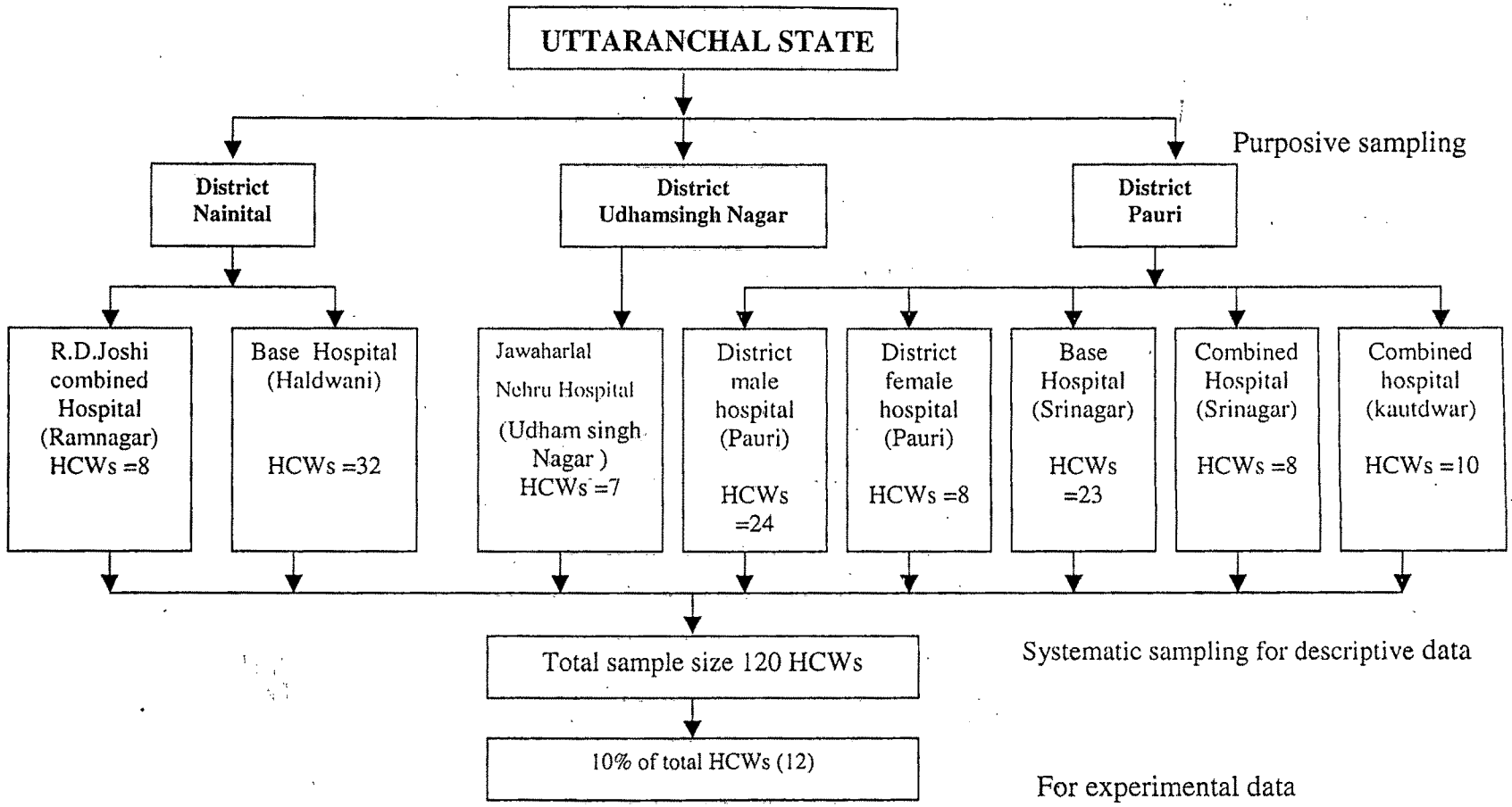


Fig 3.5.District map of Uttaranchal

Fig: 3.6 Schematic representation of sampling design adopted for the study



❖ **Sample Size**

A sample size is a definite plan for obtaining a sample from a given population keeping in view nature of universe nature of study, types of sampling technique, availability of finance, size of population of time available etc. The total sample size consisted of 120 HCWs working in selected hospitals. For the collection of experimental data 10 percent of 120 HCWs i.e. 12 were selected on the basis of a physical fitness index. These HCWs had normal blood pressure, pulse rate, approximately same age, and height, weight and BMI in each group.

➢ Method of Data Collection

The task of data collection begins after a research problem has been defined and research design has been checked out.

The data for the present study was collected in two different phases, one following another –

❖ **Descriptive Data**

Descriptive Date was collected from 120 HCWs personally by using precoded interview schedule. Besides this the three scale i.e. work stress scale, job satisfaction and burnout inventory was also used for collecting the relevant information on psychological aspect.

❖ **Experimental Data**

For the collection data 10 percent (of selected of 120 HCWs) i.e. 12 (6 nurses and 6 wardboys) were selected on the basis of their physical fitness index. For collecting data on physiological cost of work 6 activities were selected which were performed by almost all HCWs and while performing these activities majority of HCWs were facing musculoskeletal symptoms in most of the body parts. These activities are lifting patient from lying to sitting

on bed, bed making with patient in it and dressing of patient on bed, under patient handling tasks and under non patient handling tasks selected activities were bed making, moving equipments and lifting furniture i.e. chair. Physiological cost of work was measured in terms of postural stress, heart rate (beats/min), energy expenditure (KJ/min), total cardiac cost of work and pain experienced.

A modified 5-point scale constructed by Varghese *et.al,* in 1994 was used. This scale earlier was a 15 point in 1973 and then 10-point scale in 1982, which was a classic work of Swedish scientist, Gurnner Borg and was called as a Borg scale.

The modified rating of perceived exertion (RPE) scale

1. Very light
2. Light
3. Moderate heavy
4. Heavy
5. Very heavy

The scale was used to point out the pain the HCWs experienced while doing this experiment.

Different parameters were taken for the measurement of physical fitness (table 3.1) and physiological cost of work (table 3.2).

Experimental data was collected with the help of various instruments

Table 3.1 Equipment's used for measuring physical fitness of selected HCWs

S.no	Parameters	Equipments / Instruments
1	Anthropometric Measurements (cms)	Anthropometric kit
2	Body Weight (Kg)	Weighing balance
3	Physical Fitness Index (PFI)	Step Stool + Polar heart rate Monitor
4	Body Temperature (°C)	Doctor's Thermometer
5	Blood Pressure (mm/hg)	Sphygmomanometer
6	Heart rate (Beats/min)	Polar heart rate Monitor

❖ **Physical Fitness Index (PFI)**

Physical fitness index of selected HCWs was measured with the help of wooden stool ergometer. Specification of wooden stool is given in appendix- 1.

Interpretation of score:

Up to -80	-	Poor Physical fitness
80-100	-	Low average physical fitness
101-115	-	High average physical fitness
116-135	-	Good average physical fitness
136-150	-	Very good physical fitness
Beyond 150	-	Excellent physical fitness

Source: AIC RP Report (2001)

❖ **Physiological cost of work**

For measuring the physiological cost of work in terms of heart rate, postural stress, energy expenditure and total cardiac cost of work HCWs while performing activities, following formulas and instruments were used (table 3.2 and 3.3).

Table 3.2 Equipments used for measuring Physiological Cost of work of selected HCWs

S.no	Parameters	Equipments / Instruments
1	Heart rate (Beats/min)	Polar heart rate Monitor
2	Postural Stress	Flexi Curve

Table 3.3 Formulas used for calculating Physiological Cost of work

S.no	Parameters	Formulas
1.	Physical Fitness Index (PFI)	Duration of stepping x100 Sum of I,II and III min recovery pulse count
2	Energy Expenditure(KJ/min)	0.159x working heart rate (beats/min)-8.72
3	Total Cardiac cost of work (TCW)	Cardiac cost of work + Cardiac cost of rest
4	Cardiac Cost of work (CCW)	AHR x Duration (AHR= Av. working heart rate- Av. Resting heart rate)
5	Cardiac cost of rest (CCR)	AHR x Duration (AHR= Av. Recovery heart rate- Av. Resting heart rate

Cont....

6	Postural Stress	Percentage deviation = Angle of spinal cord before activity _ angle of spinal cord after activity Angle of spinal cord before activity X100
7	Body Mass Index	Weight (kg) Height(m) X Height (m) Adolphe Quetele (1798-1874)

➢ Data Analysis Procedure

The data analysis procedure covered Categorization, coding, tabulation and statistical analysis of the data.

Categorization of the variables for the purpose of analysis and tabulation: Categorization is the first step in any analysis. Categories are set up according to the research problem and purpose. For the present study, variables were categories in the following manner.

1. **Age (years):** It was categorized on equal interval basis as

Young	-	Below 30 Years
Young Middle	-	31-40 Years
Middle	-	41-50 Years
Old	-	51-above years.

2.Marital Status : It was Categorized on equal interval basis as

1. Single
2. Married
3. Divorce/Separated/Widow

3. Educational level :Education was one of the factors associated with the extent of involvement in various activities. It determined the formal education attained by the respondents. It was categorized as

1 High School
2 Inter Mediate
3 Bachelor's Degree
4 Master's Degree
5 Any other

4. Height:- It was categorized on equal interval basis as

1 120-130 cms
2 131-140 cms
3 141-150 cms
4 151-160 cms
5 161-170 cms

5 Weight: It was categorized on equal interval basis as

1 40-50 Kg
2 51-60 Kg
3 61-70 Kg
4 71-80 Kg

6. Body Mass Index: It was categorized on equal interval basis as

1 Under Weight (<20)
2 Ideal (20-25)
3 Over weight (25-30)
4 Obese (>30)

* WHO (2004)

7. Working Hours: Working hours was also one of the factor associated with the occupational health hazards that affect working of HCWs. It was categorized as

6 Hrs - Light

12 Hrs - Moderate

24 Hrs - Heavy

8. Years of Working: Working experience affects the working performance of HCWs working in Hospitals. It was categorized on equal interval basis as

O - 10 Year

11-20 Year

21-30 yrs

9. Work Place : It was categorized on the basis of types of wards / units in hospital

1- Medicine

2- Surgery

3- Operation Theatre

4- Out patients

5- Pediatrics

6- Intensive care unit

7- Orthopedics

8- Gynecology

9- Any other.

10- Work schedule: It was categorized on equal interval basis as

1- Three Shifts

1.1 Morning Shift

1.2 Evening Shift

1.3 Night Shift

2- Other Type i.e. 12 hrs and 24 hrs

Scoring: It was done to analyze the responses given against the statements in the "Work Stress Scale, Job satisfaction and Maslach burnout Inventory" the scoring was done on the basis of the scored given to the scale :-

		Score range	
1-	**Work stress scale:**	Low	(0-46)
		Moderate	(47-92)
		High	(93-138)
2-	**Job satisfaction scale:**	Low	(0-55)
		Moderate	(55-111)
		High	(112-165)
3-	**Burnout Inventory:**	Low	(0-51)
		Moderate	(52-102)
		High	(103-154)

Three separate coding sheets were developed:

1. Coding of the descriptive data
2. Coding of the experimental data
3. Coding of the psychological scales.

The information colleted were coded into the coding sheets and then transferred into tabular form.

➢ Statistical Analysis of the Data

The data were coded according to code numbers assigned and analyzed, employing descriptive as well as relational statistics. The total sample was divided into two groups on the basis of types of HCWs i.e. nurses and

wardboys, to find out the most suffering group and to make the analysis more interesting.

Descriptive statistics: The data presented in frequencies, percentage mean and standard deviation. Percentile values (5^{th} and 95^{th}) were also calculated.

Relational statistics: Deviation score method of computation of Coefficient of correlation, one-way ANOVA and Z test was used for analysis of data and testing of hypothesis.