Chapter 5
Summary and Conclusion

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Ergonomics is an applied science that deals with the adaptation of work and the workplace to the characteristics and capabilities of the worker so that he or she may perform the duties of the job effectively and safely. It addresses the worker's physical capacities in relation to the physical requirements of the job (e.g., strength, endurance, dexterity, flexibility, ability to tolerate positions and postures, visual and auditory acuity) as well as his or her mental and emotional status in relation to the way the work is organized (e.g., work schedules, workload and work-related stress). Ideally, adaptations are made to the furniture, equipment and tools used by the worker and to the work environment to enable the worker to perform adequately without risk to him/her, co-workers and the public. Occasionally, it is necessary to improve the worker's adaptation to the job through, for example, special training and the use of personal protective equipment.

The word Ergonomics is derived from the greek word "ergon" which means work and "nomos" which means laws i.e laws of work
The Ergonomics is thus a study of the human – machine system with the goals of:

- Protecting workers from serious physical or mental harm
- Maximizing worker well being
- Increasing user acceptance (corlett.2002)

Ergonomics is concerned, with the study of man's daily work. The intent is to ensure that working equipment and working environment are so designed or modified to fit the job to the man rather man to the job.

From the above concepts it can be concluded that ergonomics is the study of relationship between man, his working equipment and working environment.

Health care services

The health care services play an important role in the service sector. Health and medical services are now a major employer in all countries (Niu. 2000). It is estimated that there are 35 million health care workers (HCWs) world wide, of them some 18.5 million are doctors and nurses.

HCWs may include: all persons working in health care delivery units such as hospitals, pharmacies, ambulances and private practices i.e. personnel working in health – related institutions such as spas an rehabilitation units; personnel working in social service units, etc.

Health care is a labour- intensive industry, and it covers a highly diversified range of activities. Although some risks and hazards are common to the whole sectors. Others are more specific to certain categories of HCWs or to certain work practices.

In this health care industry, patient care demands 24 Hours/day, 7 days / week nursing coverage in hospitals and in many other health care setting. In order to meet these demands, HCWs have historically been required to work a variety of schedules, and such schedules increase exposure to physical and psychological job demands and reduces time for rest and recuperative leisure time activities (Lipscomb *et. al.* 2002).

The cost of illnesses and injuries continue to rise, posing a problem of great human and financial cost. Many of these illness and injuries are caused by potentially controllable occupational hazards (Lawenthal. 1994).
HCWs form the largest occupational group in many countries and are exposed to a great variety and concentration of hazards at the work place. These hazards

could be broadly divided into the following categories: - physiological hazards i.e. biological, chemical and physical hazards and psychosocial hazards (Niu, 1999). The most significant being musculoskeletal disorder occupational violence and sharps injuries (Smith 2001; Lipscomb 2002).

The risk for hospital workers was about 1.5 times greater than that for all workers, and it was statistically significant for all conditions, including infections and parasitic diseases, respiratory conditions, digestive system conditions and "other conditions (diseases of the ear, headaches genitourinary disorders, problems associated with child birth, disorders of pregnancy and puerperium and diseases of the skin and musculoskeletal system. (Gun, 1983)

HCWs are exposed to a great variety and concentration of hazards at the workplace .They were in direct contact with patients and infectious disease while performing different activities in hospital a big threat to their health as well as to their family. Besides the role of HCWs they also have to perform different roles in the family and that they can only perform well if they are physically and mentally fit and do not themselves pose a risk to their patients and to their family. As health care industry plays an important role in the society, so do the HCWs in this industry as well as in the family. Hospitals pose direct effect on the health of these HCWs which indirectly affect the family and the society.

The purpose of combining ergonomics with HCWs is to reduce occupational health hazards faced by them while working in hospital by taking into consideration work, worker and working environment.

Hospital ergonomics is a way of using specific information to bring about wide ranging and relevant improvements to the quality of care and to working life. It is the study of relevant human characteristics and their relationship with his/her working environment with the aim to improve efficiency, increase safety and well being of workers working in hospital.

After reviewing the literature it was found that many research studies were was carried out by United States and other countries on occupational health hazards faced by HCWs in health care industry but very little researches was done on HCWs working in hospitals of developing countries like India.

Justification of the study

Health care workers know that they face serious hazards to their own health and well being in the course of their jobs which effect their family also (Health and Safety, 1999). Attention should be drawn to the fact that personnel working in the health care sector are generally viewed as "health service providers" and are rarely seen as "workers" in need of protection. Regulations governing hospitals are usually designed to protect patients, and the health care providers. As a result, the occupational safety and health problems faced by HCWs often receive scant attention, the rate of injuries and illnesses suffered by health care workers on the job continues to rise. Little attention however is paid to this problem by employers and lawmakers. From an occupation health perspective it is essential to consider health and safety aspect and to ensure that HCWs are medically fit for their roles and do not themselves pose a risk to their patients and to their family. As home management experts we consider family as one of the important constituent of society and also for the individual living in it. The health of these individuals plays an important role on their performance both within family as well as in his work place. The family member is an important human resource and therefore his/her health is of primary concern to both family as well as society.

So, there is a need to identify occupational health hazards faced by HCWs that have direct effect on the physical and psychological cost of their work and to evaluate the work/worker/and working environment for developing guidelines for safe work surface for reducing occupational health hazards. With this background the present study was conducted to find out

occupational health hazards i.e. physiological and psychological which have direct effect on the physiological and psychological cost of work of HCWs working in hospitals. The main purpose of the study is to ergonomically assess the occupational health hazards faced by HCWs, which have direct bearing on their working performance.

The HCWs participation and active involvement are the key to a successful programme targeted at the safety and health problems in the health care sector.

Objectives of the study

1. To gain insight into worker and work related aspects of health care workers.
2. To find out the nature of work carried out by health care workers in the hospitals.
3. To identify the nature and incidence of occupational health hazards faced by health care workers
4. To find out the selected anthropometric measurements of health care workers and dimensions of hospital furniture / equipments.
5. To ergonomically assess health care workers while working in hospital in terms of -
    1. Physiological cost of work
    2. Psychological cost of work.
6. To develop guidelines to reduce occupational Health hazards for health care workers.

Limitations of the study

1. The guidelines developed would be applicable to the health care workers working in hospitals only.

Delimitations of the study

1. The study was limited to health care workers working in hospitals.
2. In the present study health care workers comprise of nurses and wardboys only.
3. The study was limited to 120 Health care workers (nurses and wardboys) from 3 districts i.e. Nainital, Udham Singh Nagar and Pauri of Uttaranchal for descriptive data.
4. For experimental work 12 physically fit health care workers were selected.
5. Only the limited wards of Hospital were studied for experimental examinations.

Hypotheses of the study

The following hypotheses were tested by employing appropriate statistical tests.

H1 : There is relationship between the selected work and worker- related variables and physiological cost of work i.e. musculoskeletal symptoms.

H2: There is relationship between the selected work and worker- related variables and psychological cost of work.

H3: There is relationship between selected worker related variables and physiological cost of work in terms of: -

1.Heart rate

2.Energy expenditure

3.Postural stress

4.Physical fitness Index

Methodology

The study "An Ergonomic Assessment of occupational health hazards faced by health care workers of selected Hospital" adopts the following methods and procedure: -

Research Design

In order to achieve the objectives of the study both the descriptive and experimental design was planned to find out the nature of work carried out by health care workers, nature and incidence of occupational health hazards experienced by HCWs and psychological cost of work. The experimental research design was planned to find out physiological cost of work in terms of energy expenditure, total cardiac cost of work, heart rate, postural stress.

Development of the tool

The pre-coded personal interview schedule was constructed keeping in view that objectives of the study. It comprises of the following section:

Section 1: This section was constructed 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 Section was divided into three parts

Part 1:- This part was again subdivided in two

Part 1: (A) included questions regarding the personal information of HCWs.

Part 1: (B) This part was constructed to gathers the information on medical background of HCWs.

Part 2: This part contained questions regarding occupational injuries & health hazards caused to HCWs while working in hospital.

Part 3: This part included questions regarding musculo skeletal illness caused to HCWs while doing patient handling tasks and non-patient handling tasks. Standardized Nordiac questionnaire was also used for the analysis of musculoskeletal symptoms.

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

Section 4: It includes various types of observation sheets and recording tables for recording data of physiological cost of activities in terms of heart rate, energy expenditure, T.C.C.W (Total Cardiac Cost of Work), postural stress physical fitness Index, work surface dimensions, and Anthropometric measurements.

Selection of the sample

1. **Selection of the locale:** The present study was carried out in 8 government hospitals having 50 or more than 50 beds of district Nainital, Udham Singh Nagar and Pauri of Uttranchal state.

The Hospitals were:

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)

2. **Sampling Design:** The multistage purposive cum systematic sampling design was used to select the sample.
3. **Sample Size:** The total sample size consisted of 120 Health care workers working in selected Hospitals. For the collection of experimental data 10 percent of selected sample of 120 HCWs i.e. 12 were selected on the basis of a physical fitness index. The HCWs had normal blood pressure, pulse rate, approximately same age, height, weight and basal metabolic rate in each group.

Method of Data Collection

Descriptive data was collected from 120 HCWs personally by using precoded interview schedule. Experiment data was collected with the help of various instruments.

Analysis of Data

The data was coded according to code numbers assigned. It was further analyzed employing descriptive as well as relational statistics. Frequency, percentage, mean, standard Deviations, coefficient of correlation, one-way ANOVA and Z test was used for analysis of data and testing of hypothesis

Major findings of the study

Major findings of the present study are presented here:

Section I. General information

Health care worker related aspects:

The mean age of HCWs was 43.16 years. The age ranged between 31-56 years. Out of the total HCWs 40 percent passed high school, another 40 percent passed Intermediate, very few of them i.e. 6.66 percent were post graduates. Married marital status was prominent among selected HCWs. The mean height of selected HCWs was 156.6 cm and weight was 58.53 kg.

Work related aspects of HCWs:

It was found that the majority (76.66 percent) HCWs selected for the present study worked in morning shift and very few i.e. 6.66 percent worked in other type of shift. Out of the total majority of HCWs i.e. 90 percent worked for 6 hrs/day and only 3.33 percent work of 24 hrs/day. It was noted that 38.33 percent HCWs had working experience between 0-10 years, 36.66 percent had between 21-30 years and 25 percent had between 11-20 years.

Section II: Nature of work carried out by health care workers

The result of the present study should that the HCWs perform two types of tasks i.e. patient handling tasks and non-patient handling tasks. Under patient handling tasks majority of health care workers performed ctivities such as moving patient in chair, rolling patient from side to side for access when washing or changing on the bed, patient care and adjusting patient's bed during feeding sitting, bed making with patient in it, lifting of patient from

lying to sitting on bed, dressing of patient on bed. Where as under non-patient handling tasks activities such as bed making, moving furniture, pulling equipments was done by majority of HCWs.

Section III: Data on medical history of selected HCWs

The joint pain emerged as a major health problem among HCWs. Few of the HCWs were suffering from diabetes, ruptured discs, and hypertension. Sixty percent HCWs experienced a "back" pain while working in hospital. Out of these 13.33 percent HCWs missed their work for back pain 6.66 percent missed for one week, 3.33 percent missed for 3 days and another 3.33 percent missed for 10 days. About 24 percent HCWs those suffering from back pain visited doctor and diagnosed back strain as a cause of the back pain.

Section IV: Work related injuries and health hazards faced by HCWs while working in hospital

It was found that 15.38 percent nurses suffered form diseases such as syphilis, malaria, tuberculosis, as a result of a prick from syringe, needles etc with in last12 month, 5.88 percent develops allergy form cleaning agents in respiratory tract due to anesthetic agents, 11.76 percent nurses suffered form skin irritation due to disinfectants/sterilizing agents, 11.76 percent slips, trips and falls 1-3 times within last 12 month especially during emergency situations. About 24 percent nurses tolerated verbal abuse from physicians, 11.76 percent tolerated absence of respect from peers and other health care professionals. Where as among wardboys 5.88 percent contracted cold as a communicable disease from the patients, .69 percent wardboys accidentally 3-4 times slips, trips and falls on wet floors especially during emergency situations, 15.38 percent tolerated abuse form physicians, 7.69 percent tolerated absence of respect from peers and other health care professionals and another 7.69 percent tolerated absence of code of conduct from all team. None of the

wardboys suffered from any type of allergy from chemical reagents; suffered from injuries such as burns, open wounds, superficial injuries, contusions, toxic effects of substances etc.

Section V: Musculoskeletal symptoms experienced by HCWs

The analysis showed that musculoskeletal symptoms i.e. ache, pain, discomfort, numbness occur more in nurses as compared to wardboys. The high risk activities in which the majority of nurses experienced musculoskeletal symptoms in most of the body parts i.e. neck, shoulder, elbow/forearm, wrist/hand, upper back, hips/thighs, knees, lower back, ankle and foot was rolling patient from side to side, dressing/washing on bed, lifting a patient from lying to sitting on a bed, making bed with patient in it, and repositioning a patient in the bed. On the other hand among wardboys the high risk activities was dressing/washing of patient on bed, lifting a patient from lying to sitting on bed, bed making with patient in it, assisting patient at using toilet, medical wound care and adjusting bed for patients during feeding, eating etc. While performing these activities wardboys experienced severe pain in neck, upper back, knees, lower back.

Among non-patient handling tasks the high risk activities in which majority of nurses experienced musculoskeletal symptoms in neck, shoulder, elbow/forearm, upper back, knees and lower back was moving furniture, bed making, pulling equipment's, writing patients notes and other administrative tasks. Where as wardboys experienced musculoskeletal symptoms in neck, shoulder, wrist/hand, upper back, lower back and knees while moving furniture, bed making, working equipment and pulling equipment and they experienced moderate pain in these body parts while performing these activities.

Section VI: Anthropometric Measurement and dimensions of hospital/furniture

The mean height of nurses and wardboys was 154.5 ±3.35 cm and 175.7 1 ± 9.95 cm. The mean eye height of nurses was measured as 145.9± 3.10 cm and of ward boys was measured as 156.08 ± 3.18 cm. It was observed that the mean shoulder height of nurses was 131.5 ±2.79 cm and of ward boys was 141.4 ± 3.61 cm. It was found that the mean Elbow height of nurses was 103.45 ± 3.90 cm and of wardboys for ward boys was 110.66 ±4.14 cm. It was noted that mean hand drip diameter of nurses was 3.5 ±0.07 cm and of ward boys was 4.0 ± 0.10cm. The mean trunk length of nurses was 95.23±2.74 cm and of wardboys was 109.25±12.74 cm. It was observed that mean popliteal height of nurses was 45.16 ± 1.34 cm and of wardboys was 50.26±2.87 cm, The mean knee height of nurses was found to be 47.91 ±0.73 cm and of wardboys was 52.16 ±2.54 cm and the mean foot length of nurses was 22.5±1.19 cm and of wardboys was 24.25±2.30cm. It was found that the hospital furniture was too low in height in comparison to the height of HCWs.

Section VII: Psychological cost of work

The analysis of psychological cost of work showed that more than 80 percent HCWs had high level of burnout and very few i.e. 1.66 percent had low level of burnout. The results contributed that the level of work stress were high in ward boys as compared to nurses. The data depicted that majority of HCWs was moderately satisfied with their job and few of them were highly satisfied.

Section VIII: Physiological cost of work

The results showed that out of total 41.66 percent were having high average (101-115) PFI and only 16.66 percent were having very good PFI

(136-150).It was found that the percentage increase in heart rate was high in nurses as compared to ward boys while making bed with patient in it and without patient in the bed. Among wardboys the percentage increase in heart rate was greater when they performed activity like dressing of patent on bed and bed making. From the finding of the present study it was found that the energy expenditure in nurses during dressing of patient on bed was 80.0 kJ/min and during bed making was 82.67 kJ/min, was highest while performing these activities. Where as among wardboys energy expenditure was highest while making bed with patient in it 57.76 kJ/min and while pulling equipment 72.55 kJ/min. The percentage deviation in angle of spinal cord was also maximum among nurses and wardboys while lifting a patient form lying to sitting on a bed and while making a bed with patient in it.

Section IX: Testing of hypothesis

There was significant relationship between age of nurses, years of working, marital status , working hours , BMI, working schedule of nurses and wardboys and burnout, work stress and job satisfaction. There was partial relationship between age, height, weight and BMI of nurses and wardboys with heart rate, energy expenditure and postural stress and physical fitness index while performing selected patient handling tasks and non patient handling tasks.

Conclusion of the study

1. From the results of the section 1 it was concluded that HCWs were in middle age group. Majority of the HCWs were married, have ideal Body Mass Index. Most of the HCWs selected for the present study worked in morning shift (6hrs) at the time of study. Most of HCWs worked in medicine ward and surgery ward at the time of study.

2. It was concluded that the task which was performed by more than 80 percent of HCWs were rolling patient from side to side for access when washing or changing on the bed, dressing/washing of patient of on bed, making bed with patient in it, assisting patient with eating/taking medicine and adjusting patients bed during feeding/sitting etc. under patient handling tasks and under non patient handling tasks were bed making, collecting equipments e.g. drug trolley, bowls for washing etc.

3. It was concluded that most of HCWs showed medical history of joint pain. The back pain was found to be most prominent among HCWs. The cause of this back pain was back strain as diagnosed by the doctor and for this pain the HCWs were taking anti inflammatory drugs as a treatment.

4. It was concluded that HCWs suffered from biological hazards due to exposure to blood borne pathogens from percutaneous injuries, splashes and other contacts, they suffer from diseases such as, malaria and tuberculosis; Chemical hazards such as irritation to the skin and respiratory tract due to anesthetic agents, disinfectants/ sterilizing agents and cleaning agents; Physical hazards due to exposure to smoke plume; accidental hazards due to slips, trips and falls on wet floor especially during emergency situations, needle stick injuries and cuts by blades, hot sterilizing equipments and electric shock from equipments with faulty insulation; violence problem due to verbal abuse from

physicians, absence of code of conduct from peers and other health care professionals. They also suffered from sprains and strains, fractures and dislocations in elbow/ forearm, ankle and foot, sacral while working in hospital.

5. It was concluded from the results that majority of nurses and ward boys reported musculoskeletal symptoms in neck, shoulder, upper back and lower back while performing patient handling tasks such as lifting patient from lying to sitting on bed, dressing/washing of patient in bed, making bed with patient in it and non patient handling tasks such as bed making with out patient in it, moving furniture and pulling equipments.

6. Considering the anthropometric measurements and the existing dimensions of hospital equipments / furniture it can be said that the furniture and equipments were not of proper height. As the work surface height for the standing work should be slightly below the elbow height namely (5-10 cm below) (Grandjean, 1988) but in the present study for the nurses and ward boys the height of hospital furniture / equipments was too low

7. The percentage increased in heart rate and energy expenditure were found to be greater in nurses as compared to wardboys. The percentage deviation in angle of spinal cord was also maximum among nurses while performing activities such as lifting patient from lying to sitting on bed with patient in it and bed making without patient in the bed.

8. It was concluded that nurses in present study showed a tendency of high level of burnout, the work induced stressors was also high in wardboys. Majority of HCWs were moderately satisfied with their job.

9 There was significant relationship found between age of nurses, years of working, marital status , working hours , BMI, working schedule of nurses and

wardboys with burnout, work stress and job satisfaction. There was partial relationship found between age, height, weight and BMI of nurses and wardboys with heart rate, energy expenditure and postural stress and physical fitness index while performing selected patient handling tasks and non patient handling tasks.

Recommendations of the study

The identified trust areas are:

1. A similar nature of study can be carried out on HCWs working in other health care delivery units such as nursing homes, health acre centers etc.

2. Considering several other variables/ factors a similar study can be conducted on the same population or even other population and area

3. A detailed study can be conducted on the same population by adopting any one specific activity.

4. A study can be carried out to find the causes of occupational health hazards and injuries faced by HCWs.

5. A similar study can be conducted on other types health care workers working in hospital