SUMMARY, CONCLUSIONS
AND
RECOMMENDATIONS
INTRODUCTION

The work included in this thesis entitled, "Shift work: Health, physiologic and psychosocial aspects" has been divided into five chapters. Chapter I contains a mini review of the studies conducted on shift workers. It also includes hypotheses and objectives of the studies. Chapter II concerns with health profiles of workers of a suburban cement plant of the Chhattisgarh region. An attempt has also been made to investigate the effect of long-term shift work on peak expiratory flow rate (PEFR), one of the measures of pulmonary function. Chapter III aims at enumerating the circadian time structure of shift workers of the cement plant. Chapter IV includes investigations of the impact of daily routine of shift workers on anxiety levels and mental health of their spouses and children. Chapter V (this chapter) deals with the summary of each of the previous chapters. This also includes conclusions and recommendations those are drawn/emanciated in/from this doctoral dissertation.

Chapter I: Introduction & A mini review

The term shift work defined as an arrangement of work hours that uses two or more teams (shifts) of workers in order to extend the hours of operation of the work environment, beyond that of the conventional office hours. The varieties of shift work include stable/permanently displaced work hours in which the work schedule used does not require a person to normally work more than one shift (including night work), rotating shift work in which an individual is normally required to work more than one shift, changing from one shift to another and unscheduled work hours. On call shift is also a special form of shift work, where in case of emergency the particular group of workers are called for their duties. The most widespread shift system is when production is organized in eight hour shifts, called morning, evening and night shifts (Knutsson, 1989).

Several workers have studied the problems of shift workers, in relation to three important factors, namely circadian, sleep and social/psychosocial/domestic factors (Monk, 1988, Folkard, 1988, 1990; Daniel and Potasova, 1989, Harma et al., 1990; Novak et al., 1990, Skipper et al., 1990). These factors should be considered while determining the shift work coping ability.
of a worker. According to Monk (1988) the circadian factors include type of shift rota, type of work to be done, age, mental and physical health, personality type and competing zeitgeber exposure. Sleep factors essentially include age, sleep need, shift system, drug/alcohol use and/or abuse, sleep hygiene and on job sleep availability. Social/psychosocial/domestic factors include moonlighting, child care and housework, commuting time, community support and housing quality. Without taking into consideration all these factors it would be difficult to develop full proof concepts that would eventually help in optimization of scheduling human shift work.

It is well known that humans sleep during the night and remain awake and active during the day. Therefore, human mind and body have not been evolved to cope with the burden of shift work in night or in any other unsuitable and uncomplimentary work schedules. Shift work can lead to a host of problems attributed to the disturbances of the circadian system in some people. Health problems imputed to shift work can broadly be classified as: disturbances of sleep, impaired physical and psychological health, and disturbed social and domestic life. Rotational shift work in general and shift work during night in particular have been proposed to be detrimental for human health by way of temporal dysfunction of human biological clock. According to several authors the circadian physiological rhythms of shift workers seldom adjust completely to the night shift (Dahlgren, 1981b; Knauth et al., 1981; Knauth and Rutenfranz, 1982; Åkerstedt, 1985; Hildebrandt et al., 1987; Folkard, 1988; Czeisler et al., 1990; Eastman, 1990). The phenomenon of aging has been found to aggravate the adverse health effects of shift work, the critical age being on an average 40-50 years (Hakkinen and Vuokko, 1988; Koller et al., 1978; Åkerstedt and Torsvall, 1981b; Foret et al., 1981; Härma and Ilmanenen, 1987). A deterioration in health has also been noticed after many years of shift work in some shift workers (Angersbach et al., 1980; Costa et al., 1981; Kundi et al., 1986). Koller (1983) has distinguished shift workers from day workers in that the health problems appeared earlier among the former than among the latter.

It has been unequivocally accepted that shift work is linked to a series of acute and chronic effects on human beings. There is an absolute need for an optimization of human shift work. This would definitely help in minimizing the occupational health hazards in shift workers and in maximizing performance and productivity. Surprisingly, very less effort has been made
in this direction in our country. Therefore, the main objectives of the present dissertation are (1) to study the health profiles of workers of the cement plant taking into consideration four important factors, such as age, sex, work experience and shift work; (2) to study the circadian time structure of the workers with reference to a number of physiologic and subjective variables, and (3) to study the impact of daily routine of shift workers on the anxiety levels and mental health status of their spouses and children.

Chapter II: Health profiles of workers of a cement plant: With a special reference to pulmonary function in shift workers

Shift workers have the increased risk of suffering from occupational health hazards as compared to day workers (Minors and Waterhouse, 1989; Akerstedt, 1990). The most prevalent complications among others are sleep disturbances, gastrointestinal and cardiovascular complaints, chronopharmacologic effects and systemic illness including exacerbation of insulin-dependent diabetes, epilepsy and neuropsychiatric disorders (Gaffuri and Costa, 1985; Brief and Scala, 1986; Knutsson, 1989; Phillips et al., 1991). In addition, incidence of spontaneous abortion has also been reported among female shift workers (McDonald and coworkers, 1988).

The effects of long-term shift work on PEFR in subjects working in a suburban cement factory in the Chhattisgarh region were examined. In addition, attempts were made to make a survey on health profiles of workers of the cement factory.

It is evident from the results that significant differences exist in the pulmonary function between day workers and shift workers as gauged by PEFR. The shift workers have consistently lower values of PEFR than the day workers. Furthermore, PEFR was found to be positively correlated with BSA in all groups of both DW and SW with statistical significance. In addition, results of this study indicate that with increasing age the frequency of clinical complications increases in both DW and SW. However, difference in the prevalence of various clinical complications between day workers and shift workers was not found to be statistically significant.
Nonetheless, a statistically significant diminished PEFR in shift workers reported in this study is perhaps novel. The possibility that the low PEFR in shift workers could be due to inhalation of cement dust has been ruled out due to the absence of statistical significance between the averages of PEFR obtained for day workers from the factory and city. In conclusion, the findings of this study demonstrate the influence of shift work alone, but not cement dust, on PEFR.

Chapter III: Temporal organization in shift workers

The earlier studies conducted by our laboratory were on subjects chosen from a local steel plant and a government hospital (Pati and Saini, 1991; Gupta, 1992; Gupta and Pati, 1993, 1994 a,b,1995; Gupta et al., 1997). The present studies aimed at investigating the effects of shift work on workers drawn from a different environment, i.e., a suburban cement factory. Attempts were made to document circadian rhythm in several variables, like skin temperature (ST), oral temperature (OT), systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), peak expiratory flow rate (PEFR), subjective drowsiness (SDr), subjective fatigue (SF) and subjective attention (SA) in shift workers from a suburban cement factory of Chhattisgarh region. In addition, circadian time structure of day workers from the city and the cement factory was also studied for comparisons.

The findings of the present studies clearly indicate that circadian rhythm in a number of physiological variables undergoes external desynchronization in cement plant workers imputed mainly to prolonged rotational shift work. Interestingly, results reported here do document rigorously that desynchronized rhythms in a shift worker could be resynchronized following his/her transfer to diurnal work. In the present case such transfer was achieved naturally following irregular but frequent shut downs of the cement factory for over a period of about 8 months and slow downs during remaining months. During the period of the closure and frequent slow downs the shift workers were assigned shift duties but there was no work to perform. Therefore, they slept in the night and behaved like any other day worker. Further when cement factory was functioning at moderate to low level the shift workers with shift duties but lesser work load did not exhibit any sign
of rhythm desynchronization in several variables. This, therefore, further confirms the hypothesis that externally desynchronized circadian rhythms in shift workers could be resynchronized following their transfer from shift work to diurnal work.

Chapter IV: Psychosocial aspects of shift work: The impact of shift work on spouses and children of shift workers

It is not known if unusual and unconventional daily routine of shift workers produce any ill effects on their day active spouses and children. This hypothesis has been tested in this chapter by examining anxiety levels and mental health status in shift workers and in their day active spouses and children.

Results clearly indicate that levels of free-floating anxiety were statistically significantly more among children and spouses of shift workers as compared with their counterparts sampled in the family of day workers from either city or factory. However, similar phenomenon could not be noticed for state anxiety. In contrast, trait anxiety was statistically significantly more in children of shift workers and day workers from factory as compared with the children of day workers from city.

In addition, results of this study clearly reveal that the status of mental health is statistically significantly low among shift workers as compared with their day working counterparts. Furthermore, interestingly levels of mental health of the spouses of both industrial day workers and shift workers were significantly lower as compared with the spouses of the day workers from city. Neither shift work nor industrial work did produce comparable effects among the children. Fortunately, an increase in the level of free-floating anxiety in children of shift workers was not associated with a concomitant statistically significant decline in the status of their mental health. However, an inverse relationship was apparent, although it was not statistically significant. Had the relationship been statistically significant situations could have been alarmingly dangerous.

Results reported in this chapter are novel and perhaps it is the first study that not only addresses the problems of shift workers alone but also that of their spouses and children in respect of anxiety level and mental
health status. These results do provide a strong basis for carrying out studies that would include psychosocial variables for favour of assessing the ill effects of shift work in general.

RECOMMENDATIONS

On the basis of these studies it is recommended that in each and every work places where shift work is mandatory, chronoclinics should be established. Trained health care personnel of the chronoclinics should monitor intermittently (preferably every alternate year) the state of the biological clock (synchronized or desynchronized?) of each shift worker and upon discovering rhythm desynchronization his/her transfer from shift work to day work for at least one year should be recommended to the employer/management. This would perhaps rule out the possibilities of ill effects of shift work that are expected to be impinged upon the workers. It has been proposed that while examining tolerance/intolerance of shift workers to rotational shift work the levels of anxiety and mental health status of the individuals under scrutiny should be taken into consideration. Sleep-wake disorder is another important variable which can not be simply ignored while ascertaining intolerance to shift work. Appropriate chronotherapy should also be administered into intolerant shift workers, in addition while they are being transferred from shift duty to day duty. A model has been proposed with a view to optimize shift work (Figure 5.1). This model takes into account most of the important variables those are thought to have a bearing on effective management of shift work.

Interestingly, results from animal studies indicate that alteration of LD schedules comparable to some extent with shift work schedules induces a decline in the longevity of the test organisms. This hypothesis is yet to be tested in human shift workers. Therefore, it would be difficult to speculate if recommendations forwarded above would counteract the effects (if any) of shift work on eventual longevity of the shift workers.

Undoubtedly, the present dissertation is the second one that addresses the problems of shift work in India. The results obtained and documented in this thesis might help in formulating guidelines to have shift optimization leading to the maximum productivity in the industries and other work places with the least health hazards to the shift workers.
Figure 5.1: Model suggesting optimization of human shift work