Adaptation to Night Shifts and Synchronisation Processes of Night Workers

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Abstract  Human beings are accustomed to being active and awake during the day, and asleep and rest at night. Since we live in a society which is organised predominantly along daytime activity, therefore working in the night shift may deeply disrupt our social and family life. It is also a well-known fact that night shift causes fatigue and circadian disruption. The basic manifestation of fatigue and circadian rhythm has been linked to health and safety problems, involving decrements in psychophysical and physiological functions, plus subjective complaints. In this context quantitative relationships between shift work and circadian rhythm need to be assessed to explore suitable time schedule, and to minimise sleep depth and fatigue. There is also a great need to discuss circadian disruption, sleepiness and the increasing cost of work related illness among night workers. In this regard, some aspects of fatigue and circadian disruption caused from night shift work are revealed in this paper aiming to increase workers’ health, safety and wellbeing as well as productivity. Light / dark cycle and social stimuli issues acting on the circadian timing systems are also explored to solicit opinions and discussion on the controversy of night work. Suggestions are therefore likewise given to enhance workers’ adaptation to night shift and synchronization process.


Keywords: night shift, fatigue, circadian rhythm, synchronization, occupational medicine, adaptation

Introduction

Circadian rhythm (CR) and night work are very important as a balancing factor within our social and industrial context. Night work, however, inherent to industrial activity is often treated as a source of fatigue and disruption of CR (Wever, 1979; Minors and Waterhouse, 1986). These issues are critical not only from an occupational point of view, but also from the industrial production, employment and national economy point of view. Night work aggravates a worker’s health, safety and wellbeing to a great extent. It hampers health practices such as sound sleep, improved diet, and regular exercise. Acting as a stress factor through the conflicts between the endogenous biological rhythms and the external synchronisers, night work also reduces psychosocial relationship with family members, friends and other people. Family interactions among the night shift workers usually take place because he/she cannot spend time (e.g., mealtime and bedtime) with family members. The major risks of night work have been identified as severe damage to the workers’ ability in performing duties (Costa, 1996; Ahasan et al. 2001a). Chronic fatigue, tiredness, psychiatric disorders or consuming diseases are the usual symptoms found among night workers, and can be a major reason why night shift workers retire early. When the levels of work effort and ill symptoms for different timing of shift work are compared (Kerkhof, 1985; Gupta and Pati, 1994), night shift workers are known to have a higher morbidity of gastrointestinal and pancreas illness, hepatic disorders and cardiovascular dysfunction (Monk, 1986). A large amount of absenteeism among workers on night shift is therefore common. The impact of night work on psychosomatic and psychological well being is interrelated (Mott et al., 1965; Bohle and Tilley, 1989). The performance of the night shift workers in terms of efficiency and productivity is lower because it causes desynchronization of the normal CR (Wyatt and Marriott, 1953; Folkard, 1992). CR, night work and mechanisms of diurnally active human symptoms were explored in some studies (Minors and Waterhouse, 1986; Pati and Gupta,
Night Shift and Circadian Rhythm

Circadian is a Latin word, which means “around a day”. CR means activity-rest cycle and is usually referred to as the basic rest-activity cycle. It is also treated as the human biological clock, which adjusts body functions, especially during night shift activity. CR induces a warm up inertia into our biological system. However, it can be a time keeping system inside our brain that has a momentum of its own. The human circadian system serves to determine how well someone can cope with shift work (Monk, 1988). Therefore, there is a lack of protection from nocturnal sleep among the night workers. Since human society itself is a diurnal culture, the biological clock is unlikely to be fully adjusted to the night shift. Night work is often treated as continuous jet lag with human CR (Costa et al., 1989; Rosa, 1990). Circadian disruption is also considered as a factor in decreased waking alertness (Folkard et al., 1995), impaired performance and worsening mood (Mott et al., 1965). A night work usually induce phase-shifting problem (Wever, 1979) due to introversion and neuroticism caused by desynchronization of human CR. This process is associated with nocturnal sleep, fatigue and CR that is genetically programmed to regulate sleep-waking cycle. Personality and behavioural characteristics of night workers are unlikely to change due to changes of CR (Kerkhof, 1985). Age, light exposure, or social interactions may also account for some of the individual differences in fatigue and circadian disruption (See et al., 2000). Since human activities are usually preferred in the daylight, fatigue and circadian disruption is associated with night work. Nag et al. (1997) and Ahasan et al. (1997) noted that permanent night shift workers are less tolerant in hot environments. CR is mutually interactive with sleep practice, exercise, domestic activities, food quality, and/or nutrition. The socio-economic, political and other local factors (Fig. 1) are also subject to night time activity that need to be adapted to human circadian system.

Circadian characteristics influence individual differences in tolerances and adjustment to night work (Costa et al., 1989). The chronotype characteristics (i.e., stability of CR) depend on the measurement of some variables such as core body temperature, cortisol secretion and others that influence human biological clock. Variations of chronotype characteristics can also be observed among the night workers in all the geographic zones, especially where there is considerable variation in the length of day and night (e.g., winter—summer differences in the Scandinavia). However all those physical, environmental and psychosocial factors should be carefully considered when workers are assigned to night shift work. A simplified network of night shift rota (Ahasan et al., 2001b) is illustrated below (Fig. 2) by endorsing human aspects of shift work, CR and synchronization process.

Night work entails a progressive change in the phase of the workers’ physiological daily rhythmic functions. Both immediate and long-term effects of night shift are identified due to disturbances of his/her circadian or biological systems (Folkard, 1984). The health and safety problems are also seen as hormonal irregularities, epilepsy, and seizures of other genesis. Desynchronization of circadian properties or a loss of harmony in CR occurs when both human biology systems go against the interests of the hapless night worker. Fredholm (1985) and Anonymous (1986) noted that human chronopharmacology such as drug activity and effectiveness also has a clear relation with CR and fatigue symptoms. The circadian pattern of such susceptibility to work-related exposures evolved from physical, chemical and biological agents (Smolensky, 1981). However the circadian variations of susceptibility of a bio-system in exposed and non-exposed workers are different according to some researchers. Night work at the circadian nadir can show a lower level of physiological activation. Awakening from naps around the circadian nadir can be unpleasant (Naitoh et al., 1993). Breaks are unlikely to have effects on sleepiness induced by circadian or homeostatic factors. Breaks should therefore be reserved for sleepiness due to time on task, since such effects on alertness and performance are temporary. Alertness and performance may also show a time of day pattern with a maximum in the late afternoon and a trough in the early morning (Dijk et al., 1992; Folkard et al., 1985). A gradual fall in alertness or work performance in connection with forced desynchronization was noted by Dijk et al (1992). There is a lack of field studies of the...
Fig. 1. A comprehensive model endorsing work characteristics in night shift.

Fig. 2. The simplified network of night shift rotas (Ahasan et al., 2001b).
effects of bright light on alertness since most complaints of shift workers are related to sleep disturbances. Sleep difficulties may be partly social but there is a strong circadian influence on sleep latency that makes early initiation of sleep difficult (Åkerstedt et al., 1992; Folkard and Barton 1993). Greater sleepiness may occur during night time driving compared with driving in daylight when diurnal periodicity is taken into account (Badia et al., 1991). Knauth et al., (1978) and Knauth and Rutenfranz (1976) observed less disturbances of circadian physiological functions. It is true when only a few consecutive night shifts are worked. Pin et al., (1969) noted higher alpha activity, a reduced heart rate, greater variability in pulse and heightened blink frequency while driving at night. Late night exposure before the circadian nadir delays the rhythm whereas morning exposure advances the rhythm. The pineal hormone melatonin has been claimed to counteract jet lag (Arendt et al., 1987; Petrie et al., 1989). It is also difficult to foresee a widespread use of a hormone in order to make shift work feasible.

Sleep-Wake Rhythm

The sleep-wake cycle is the basic condition for the workers’ health, safety and well being. The optimisation of the sleep-wake rhythm will be rather difficult due to misinterpretation or desynchronisation of CR (Knauth et al., 1980; Reinberg et al., 1980; Gupta and Pati, 1994). A human worker associates his/her own state of wakefulness and activity to daylight, but industrial activity does not operate in this manner. Industrial activity means a continuous production that is not compatible with human nature. Industries also expect people to be involved in night shift work for continuous production but many workers are not able in performing their activities well. Due to the inversion of the normal sleep-wake cycle, workers may acquire a misalignment between their psychophysiology and CR (Breithaupt et al., 1978). Therefore, a balanced sleep-wake cycle is a vital issue to minimise desynchronisation of CR. The individual’s natural biological clock may not be prepared for having a restful sleep because of night shift (Barton and Folkard, 1993). Sleep can be inconvenient or influence the normal process of recuperation. The night shift worker sleeps less, sometimes 2–3 hours less per day (Kogi, 1982). They wake up early due to disturbances of surrounding environments (e.g., high temperature, dusts, noise, telephone, children’s crying, doorbell, etc). Night shift significantly causes delay of the first burst of sleepiness at daytime due to many other reasons (Åkerstedt, 1988). It is no doubt that natural daylight can be treated as an enemy to the night worker, mainly due to nocturnal circadian orientation (Czeisler et al., 1990).

Individuals with sleep apnoea have a 2–3 fold greater risk of having accidents (Ong et al., 1987; Nag and Patel, 1998), especially in cases involving monotonous night shift jobs. If the task is monotonous and repetitive, there can also be a post-lunch dip at which human beings have a propensity to fall asleep. Therefore the rate of accidents may be increased in such job-activities. Larger accumulations of sleep deficits may likely occur if there are several night shifts in a row (Escriba et al., 1992). Phase advancing of their sleep-wake rhythm in turn leads to shorter sleep of lower quality. Sleep deficit can also accumulate after a single night shift or two night shifts pursued by an industrial worker (Khaleque and Rahman, 1982; Åkerstedt, 1988). Gadbois (1981) studied inter-indigence of sleep and off-job activities of women on night shift. Khaleque (1990; 1991) found some effects of diurnal and seasonal sleep deficiency on work effort and fatigue among both men and women workers. Duration of sleep depends on the type of shift work, surrounding environment, exercise, food intake, and other factors (Knauth et al., 1980). For sleep duration and sleep quality, the standard shift work index included retrospective alertness ratings. A short nap, rest and tea or coffee break can improve alertness in a night shift and minimise sleepiness (Sallinen et al., 1997).

Fatigue and Circadian Rhythm

Fatigue among the night workers is likely to be candid or lukewarm for different reasons. Fatigue, however, is punctually linked to sleep deficit and ill health (Kogi, 1982; Koller, 1983). There is a direct mechanism related to fatigue that is usually observed more quickly with increasing time. Fatigue may arise from job demand, work-environment and/or job responsibility. Jobs requiring greater energy expenditure (e.g., lifting, carrying, pushing, pulling or climbing) are likely to produce higher levels of stress and/or fatigue. Psychophysical performance of the shift worker decreases greatly in cases of high accumulation of fatigue. Increased fatigue caused by nightshifts may result in musculoskeletal pain, accidents and injuries (Osiri et al., 1994; Smith et al., 1994; Abib et al., 1998; Ahasan et al., 2001a). Fatigue may however appear in non-shift workers if the tasks are monotonous or repetitive. Fatigue is an important predictor of psychosomatic and cognitive stress (e.g., angina pectoris, depression, hypertension, mental load or anxiety). Fatigue as the symptoms of boredom, tiredness, sleepiness, and laziness depends on the individual’s adjustability to night shift activity and CR. The human circadian phase reflects on the workers’ regular exercise, improved diet, sound sleep and pleasant home environment. Individual changes of behaviour or fatigue symptoms however vary in different workplaces (Kerkhof, 1985). Therefore it will be better to compare the relative contribution of fatigue and CR, and
on the impact of such changes from night work. Fatigue is more pronounced among permanent night workers than rotating shift workers. A unique shift system is therefore necessary to satisfy workers in their social, family and leisure activities.

Fatigue may vary due to different activities in different time (Yoshitake, 1971). For instance, fatigue level is usually high in the beginning of the morning shift. Fatigue may also arise in the pattern of change of circadian recovery across the different seasons (Pokorski et al., 1997). There can be a possibility of shift-dependent fatigue effects due to the impact of seasonal variation (Khaleque, 1991). Lengths of a nocturnal nap, break or rest have positive effects on reducing fatigue and illness symptoms (Saito and Sasaki, 1996). For instance, the timing of shift changeovers is important in reducing chronic fatigue especially in tropical climates. In the case where industrial workers are involved with jobs in hot environments, CR and fatigue should be assessed from hourly plasma melatonin and from core body temperature (Colquhoun and Folkard, 1978).

**Effect of Day or Bright Light**

The administration of bright light can have significant effects on human CR. Exposure to bright light leads to phase differences of shift workers that may disturb them from getting a sound sleep (Czeisler et al., 1990). Beersma et al. (1999) also illustrated the accuracy of human circadian entertainment under natural light conditions. Day light, however, can be sensitive for the human biological clock mainly due to non-adaptation with local or domestic environment and/or non-synchronising system of human body-mind. There is still some debate over the optimum timing, duration and intensity of bright light. Indoor artificial light (normal range = 180 lux) can phase advance on the human circadian system but exposure to 250 lux can significantly delay the human circadian phase (Boivin et al., 1997). These sort of delays may be induced by higher levels of luminance, which could effect the speed of adjustment to the ability of doing night work. Bright light (1500 lux) regulates the pacemaker (Boivin et al., 1997) but it can be bad for adjusting to the circadian or homeostatic phase. Shanahan and Czeisler (2000) also illustrated the physiological effects of light on the human circadian pacemaker. The growing awareness of contrast from the bright light and its impact upon the sound sleep and disruption of CR was also revealed in many other papers. The effects of daytime activities on slow wave sleep and body temperature was described by Kobayashi et al. (1991). Bjorvatn et al. (1998) noted that workers had slow re-adaptation after returning home from the oil platform. However those workers had a rapid adaptation to night work at the oil platform in the North Sea. In another study, Bjorvatn et al. (1999) found that bright light treatment was somehow useful for adaptation to night work and re-adaptation to day life. Eastman and Martin (1999) studied how to use light and dark to produce circadian adaptation to night shift work. Bright light induction was also discussed by Czeisler et al. (1989) for resting of the human circadian pacemaker. In this context, Boivin et al. (1997) wondered if there are responses of the phase shifting effects of day light on the human circadian pacemaker. Gaffuri and Costa (1985) also noted on applied aspects of chronoergo-hygiene that could be helpful to minimise problems of human circadian phase, biological phenomenon and/or pacemaker. The longer and stronger stimulation of hormonal systems in daylight can be reflected in unimodal rhythms of immunity, metabolism and other physiological parameters (Shanahan and Czeisler, 2000). The increase of light or brightness leads to a broadening of human activity phase of about 3–4 hours (Pokorski et al., 1997). It has also been identified that dark room sleep is encouraging for recovering the sleep deficit. A dark room can be used to ameliorate the effects of night work in terms of getting sound sleep. Usually, bright light has the effect of changing circadian phase in humans (Czeisler et al., 1989; Lewy et al., 1983). The mechanism seems to be exposure to light at a particular circadian phase (Czeisler et al., 1990, Minors et al., 1991). It is too early to judge whether it is by the way of adjusting the body clock or through hypnotic or some similar action (Anonymous, 1986; Reinberg et al., 1989), because the mechanism of action of jet lag has not yet been established. The duration of exposure to such light is around 2–5 hours and the intensity may be approximately 1200 lux (Boivin et al., 1994; Czeisler et al., 1995; Jewett et al., 1994). The sensitivity to light exposure (Eastman, 1992; Thessing et al., 1994) seems to be maximum immediately before and after the circadian trough but it disappears within 4–5 hours, away from trough (Dawson and Campbell, 1991). Night work adaptation remains stable even when night work proceeds under dim light. Bright light also seems a logical fatigue countermeasure (Åkersted and Landström, 1998). Bougrine et al. (1993, 1995) explored the social feasibility of bright light. Every weekend in between normal day life seemed to cause a turn back.

An appropriate use of bright light induces a rapid and stable biological clock adaptation to night work in spite of preventive effects of a natural environment and day life during the rest period. Czeisler et al. (1981) introduced chronotherapy for re-setting the circadian clock of workers with delayed sleep phase insomnia. Indeed, there is no need, as Folkard (1990) suggested, to create a nocturnal sub-society that does not only work at night but also remains on a nocturnal routine on rest days. Daynight simulation of process control could thus be helpful.
in assessing the hypothesis of circadian variations. The phase response curve (Minors et al., 1991) for both phase advance and delays produced by bright light in different circadian phases are very important. Bright light for phase shifting is a subject arousing a great amount of interest in research on night shift work. Spontaneous wake-up does not prevent the bright light circadian phase delay. Changes in light simulation will also activate the reticular system apart from changing of the circadian phase. It is difficult to measure phase shifting because of phase re-setting light, that may not be easily available during time off, especially while using light during working hours.

**Adjustability and Adaptability**

The degree of adaptation of human CR cannot normally be achieved in night shift. Circadian variation of psycho-physical, physiological and cognitive functions might not be easily fit among the night workers (Härma et al., 1990) because it compels the worker to invert his/her normal activity-rest cycle and forces them to adjust body functions. Factors for promoting adjustment to night shift work were discussed in a few papers (Rosa, 1990; Ahasan et al., 2001b). In some studies (Hakkinen, 1969; Monk, 1988; Härma, 1993) it was found that an individual’s body clock adjusts after 10 or more nights. Härma (1993) expressed concerns on individual differences in tolerance to night shift work. Many workers cannot adjust their life cycle around a nocturnal working schedule due to various reasons (Barton, 1994). A general malaise and accumulated fatigue may result from night work due to the incapacity to adapt or adjust CR. Therefore physical characteristics, physiological parameters, social repercussions, and environmental factors are important especially when adjustment of shift schedule is not being considered (Monk et al., 1978; Costa et al., 1989). Folkard (1984) conducted a test survey among night workers who adapted poorly with his/her CR and formulated a suitable model for CA to shift work. Dahlgren (1981) described long-term adjustment of CR. A physiologic maladaptation of body temperature rhythm to night work was evaluated by Czeisler et al. (1990). Hakkinen (1969) explored human biological and adaptable mechanisms and how to increase adaptability to night time activity. However, tolerance to night shift and sleep is related to the individual’s circadian phase position (Breithaupt et al., 1978). An early peak of urinary production could predict a difficulty in night work adaptation. Colquhoun and Folkard (1978) evaluated the relationship between CR and fatigue to its adjustment to night work. Folkard et al. (1995) surveyed on these measures to assess circadian variations in alertness. It is evident that peak melatonin secretion during the night shift may lead to lowered alertness and performance. An alertness counselling program is therefore important to adapt coping style on night shift. Day sleep duration for a night worker depends on the level of adaptation, which is more or less, advanced on the mornings-evenings (Foret and Benoit, 1978; Härma, 1997). Appropriate circadian time and/or adjustment with the biological clock may help workers to minimise fatigue. Many workers who are unable to shift on their own, can remain at a relatively fixed circadian phase (morning-evening). Foret and Benoit (1978) found that the level of adjustment to night schedule was rather difficult especially when workers’ CR were not synchronised with the essential elements of domestic life. Circadian phase adjustments to night shift work is thus defined as the tolerance to shift cycles (Knauth and Rutenfrazn, 1976). The time to adapt the CR has been identified by Costa et al. (1989) and Rosa (1990). A substantial proportion of night workers can thus shift their CR after a week (e.g. minimum standard time to adapt their biological clock). A rating of the adaptation to night shift were indicated in many studies (Foret and Benoit, 1978; Colquhoun and Folkard, 1978; Härma, 1997). However some authors (Horne, 1981; Folkard, 1984) opined that internal desynchronization can be apparent when subjects are given opportunities for sleep at different times. It means workers need sound sleep to match his/her own biological clock, to be acquainted with, and adjusted to the night shift. There can be symptoms of sleepiness during night jobs because of the inappropriate CR. The process of adaptation or tolerance to night shift work may develop through the design of suitable timing, and introduction of naps or rest.

**Synchronization Process**

The techniques of synchronizing the human circadian system have not been adequately tested in real life situations. There are many studies on circadian adjustment (CA) to night work but it is still not clear whether CA is correlated with subjective alertness or behavioural efficiency, or something else. The effect of days off or rest frequency is important for circadian synchronization during sleep recovery after several night shifts. The circadian pacemaker will usually free-run at a non-24 hour frequency because oscillation of the human circadian clock is clearly a self-sustained CR (≈ 24 hours). It is usually driven by the pacemaker in the suprachiasmatic nuclei of the hypothalamus (Klein et al., 1991; Moore and Eichler, 1972). The CA of shift workers is perhaps difficult because of adjustment of CR. Sleep wake pattern to night work is related with the cycles of the nocturnal system (Dawson and Campbell, 1991; Czeisler et al., 1991; Eastman, 1987) and the masking effects of night shift work (Folkard, 1988, 1992; Wever, 1969). For instance, day sleep among permanent night
workers can be deep if they work on rapidly rotating systems (Telle et al., 1991).

The adjustment to a new circadian phase position will occur at the speed of one hour per day (Mills, 1976; Wever, 1980). Wilkinson (1992) argues that there is a better adjustment to night work. Studies of temporal isolation (Aschoff, 1965) spontaneous (Folkard et al., 1985) and forced desynchronization (Czeisler et al., 1995) showed the degree of CA to which shift workers adjust their endogenous clock to night work. External stimulation will be an additional factor because the nervous system is built to increase activation through amplification of (change in) sensory input (Morruzzi and Magoun, 1949). Repetition of the same stimulus will cause habituation, that is, a reduction and eventual cessation of activation response (Sharpless and Jasper, 1956). Novel and sudden stimuli will always evoke arousal responses (Sokolov, 1963). Any situation that creates monotony (i.e., absence of stimuli or due to sequence of similar stimuli) will impair alertness and performance in connection with the neuro-physiological symptoms (Wilkinson, 1969). No complete adaptation to night work can be achieved during a night shift period (Van Loon, 1963). It is especially true when there are several weeks in succession every week. Sleep is very difficult at the acro-phase (i.e., maximum) of body temperature rhythm and easy at the nadir (Czeisler et al. 1980). In order to verify the relationship between the night work adjustment and the amplitude and phase of aMT6s rhythm, Moog (1988) and Bougrine et al. (1998) illustrated on phase delay of night shift workers' baseline of aMT6s rhythm. CA is more favourable for workers with late onset melatonin production related to the time of bright light exposure (2:00–5:00 a.m.). There is no turn back even when the CA to night work is partial. Indeed, daytime sleep loss is more important when there is no night work adjustment. This daytime sleep loss can be compensated for by an increase of nocturnal sleep length on a rest day leading to a normal sleep duration (Webb, 1969). Circadian fluctuation in the mode of information processing would be in contrast to a stable mode of reasoning for night shift work. Many of us expected that, depending on human’s internal state, workers might base their reasoning on either synthetic or analytic information.

### Discussions

Shift work, either in day or night time, is an essential element of industrial economy and social progress. Recent advances with respect to improved health, safety and tolerance to night shift work are illustrated in many papers (Rutenfraz et al., 1985; ILO, 1988; Wedderburn, 1991; Kogi and Thurman, 1993; Kogi, 1997). Methods for preventing sleepiness have been discussed by Rosa (1990) and Åkerstedt (1996). Night shift can be suggested in some situation if it does not cause health and psychosomatic problems. Consecutive night shifts were found to be considerably better than those which rotated on a weekly regime (Monk, 1986, 1988). Individual’s coping strategies can however be improved through regular diet, nutrition, exercise, job training, and health/safety measures (Table 1).

Sound sleep may occur after some exercise (Torsvall, 1981). Social environment or days off may directly prevent the bad effect of night work adjustment. However, coping strategies in night shift are often more difficult for many industrial workers compared to day or evening workers. Scott and LaDou (1990) recommended medical surveillance and screening for the bad effects on sleep depth and health problems. The potential usefulness of melatonin treatment is illustrated in some

### Table 1. Some recommendations for the improvement of night shift work (Ahasan et al. 2001a)

<table>
<thead>
<tr>
<th>Features</th>
<th>Health and safety measures/recommendations</th>
</tr>
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<tbody>
<tr>
<td>Shift sequence</td>
<td>Minimise the use of permanent night shift</td>
</tr>
<tr>
<td>Work Sequences</td>
<td>Avoid overlong work sequences</td>
</tr>
<tr>
<td>Succession</td>
<td>Reduce the number of successive nights to a max. of 2 to 3</td>
</tr>
<tr>
<td>Succession of afternoon shift</td>
<td>Reduction of the no. of successive afternoon shift to a max. of 4</td>
</tr>
<tr>
<td>Intervals of time off</td>
<td>Avoid short intervals (e.g. less than 11 hours) of time off, and prefer moderate starting time (22:00–24:00 hours) between two consecutive shifts either in the night shift or in the afternoon shift</td>
</tr>
<tr>
<td>Free weekends</td>
<td>Provide some free weekends with at least 2 consecutive days off</td>
</tr>
<tr>
<td>Rotation</td>
<td>Prefer forward rotation of shift system</td>
</tr>
<tr>
<td>Regularity</td>
<td>Prefer regular rotas of shift system with some days off</td>
</tr>
<tr>
<td>Length of shift</td>
<td>Fix it according to workload or frequency of task, make it shorter</td>
</tr>
<tr>
<td>Changeover times</td>
<td>Prefer flexible shift changeover times</td>
</tr>
</tbody>
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Conclusion

Night shift has both advantages and disadvantages from a circadian point of view. Night work could be harmful for many workers in their health and safety especially when synchronising processes are complex. Since human life cannot be understood without work activity, the positive side of night shift should be prioritised as it provides employment, enhance industrial production and national economy. Someone could schedule his/her leisure time around shift work because there are days off during the weeks. The workers who have night duty can enjoy some portion of daytime activity or evening time because of night shift rotation. It is therefore possible, for night workers, to maintain family and social life activity. Other advantages of night shift are: night-time activities are not usually as tightly supervised; there is less job pressure, and the workers may feel free and relaxed. The workers are supposed to be able to help each other and hence work performance is likely to be better on night shift. Some workers can be relatively happy and productive while they are working at night. There is a less crowded work environment, reduced noise, less interruption from management, and flexibility in job-tasks. Night shift workers do not worry as to whether they will have to wake up in time, and prepared for work, which can be seen among morning or day shift workers. In spite of disturbances of CR among night shift workers, many of the industrial workers may have the ability to make a commitment to a nocturnal way of life. Although night shift work causes various problems while contributing factors are possible to minimise, it is possible that he/she can adapt with corresponding factors.

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