Shiftwork tolerance and 24-h variations in moods

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The objective of the study was to identify the differences in 24-h variations in moods between three groups of oil-refinery workers: tolerant shiftworkers, intolerant shiftworkers and workers who had never worked in shifts. Each group comprised 29 workers matched by age. The mood measurements were taken during a 24-h period every 2 h starting from 08:00 h. Results were scored for three scales: positive moods, negative moods and fatigue. The two-factor ANOVA revealed the significant main effect of groups for all three moods indicating differences at the average level of 24-h variations in all moods between workers who differed in the degree of tolerance to shiftwork. The significant main effect of time of day was also found for all moods while the reliable interaction between groups and time of day was observed for negative moods only, indicating a different shape of 24-h variations for non-shiftworkers in comparison to shiftworkers.

1. Introduction

Many studies have confirmed time-of-day variations in mood, although most of them have dealt with the diurnal period and only a few with the whole 24-h period (Barton and Cattell 1974, Taub and Berger 1974, Thayer 1987, Castro 1987, Radošević-Vidaček et al. 1990). It is well known that mood viewed as the current affective state of an individual could be influenced by various psychological, physiological, social and situational factors. However, in constant conditions, when various relevant factors are controlled, mood can exhibit its circadian rhythm.

There are several studies showing that psychological variables like fatigue and different affective states are influenced by shiftwork and especially by night-shift (Tasto et al. 1978, Wynne et al. 1986, Bohle and Tilley 1993). According to Reinberg and co-workers (1984a) intolerance to shiftwork, as well as persisting sleep disturbance and digestive troubles, is associated with persisting fatigue and changes in mood. Lowered well-being, often

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reported in shiftworkers, may lead to complaints like nervousness, fatigue, premature tiredness, depressive symptoms and aggressive behaviour (Koller et al. 1981).

There are a limited number of studies of mood ratings throughout a 24-h period in shiftworkers, and especially of the relationship between certain circadian characteristics of moods and tolerance to shiftwork. This study attempts to identify the differences in 24-h variations in moods in three groups of oil-refinery workers: tolerant shiftworkers, intolerant shiftworkers and the workers who had never worked in a shift.

2. Methods

2.1. Subjects

The subjects were three groups of male workers employed in a large oil refinery, matched by age (mean age = 39.9 years, range = 29–53 years).

From a total of 604 shiftworkers who were administered the Sleep Quality scale and the Psychosomatic-Digestive Complaint scale, used as indices of (in)tolerance to shiftwork, only subjects whose results were found to be at extreme ends of the range of these two scales were chosen.

A group of subjects tolerant to shiftwork (n = 29) consisted of workers with good quality of sleep and less psychosomatic and digestive complaints who achieved extremely high scores in the Sleep Quality scale (average Z score = +1.3) and low scores on the Psychosomatic-Digestive Complaints scale (average Z score = −0.8). Another group were subjects intolerant to shiftwork (n = 29) with poor quality of sleep and more psychosomatic and digestive complaints. They achieved extremely low scores in the Sleep Quality scale (average Z score = −1.3) and high scores on the Psychosomatic-Digestive Complaints scale (average Z score = +0.4). The shiftworkers were working in a 2:2:3 continuous three-shift system that rotated in the order: morning (06:00–14:00 h); afternoon (14:00–22:00 h); night (22:00–06:00 h); days off. The third group (n = 29) consisted of workers who always worked in the morning and had never worked in shifts (in further text referred as non-shiftworkers). They had significantly better quality of sleep (p < .01) and less psychosomatic and digestive complaints (p < .01) than intolerant shiftworkers and did not differ in these characteristics from tolerant shiftworkers.

2.2. Instruments

The Sleep Quality and Psychosomatic-Digestive Complaints scales that were used as criteria on which the groups of shiftworkers were selected are described elsewhere (Vidaček et al. 1989, Kaliterna et al. 1993).

The mood was assessed by means of the Adjective Check List (ACL, Taub and Berger 1974) consisting of 57 adjectives presented in a randomized sequence. Each adjective was scored on a five-point intensity scale as 0 ‘not at all’; 1 ‘a little’; 2 ‘moderately’; 3 ‘quite a bit’ or 4 ‘extremely’. The subjects described their current mood with their first reaction to each word. The results were scored for three scales: positive moods (based on 19 descriptors), negative moods (based on 25 descriptors) and fatigue (based on 8 descriptors), in accordance with the results of a principal component analysis performed on 24-h ratings for ACL descriptors (Radošević-Vidaček et al. 1990).

2.3. Procedure

The study took place in the company recreation centre in rooms specially adapted for this purpose. The day before arrival shiftworkers were not scheduled for night-shift. Subjects
came in the afternoon, a day before the measurements were taken. During the afternoon the subjects were given instructions, they had dinner, went to sleep at about 22:00 h and woke up at about 06:30 h the next morning. The twelve measurements of moods were taken every 2 h starting from 08:00 h.

Between measurements the subjects were accommodated in a large room, they were allowed light activities (i.e. playing cards, reading, listening to music) but were instructed not to sleep. They were allowed to smoke, but were not allowed alcohol, coffee or tea. The subjects were given meals immediately after the end of the measurement sessions at 10:00, 14:00, 18:00, 21:00 and 06:00 h.

The ambient temperature in the rooms was held approximately constant at 21 °C. Continuous artificial lighting at normal interior lighting intensity was provided in all rooms where the subjects stayed.

2.4. Data analysis
Data was evaluated by the two-factor ANOVA with repeated measures on the second factor (3 groups of workers x 12 times of day). For the significant main effect of groups pairwise comparisons were made (Scheffé). For the significant interaction additional analyses were performed by one-way ANOVA with repeated measures for each group.

3. Results
Obtained results are presented separately for each mood scale. The display of average data as a function of time of day are plotted for each scale.

3.1. 24-h variations in positive moods
During the 24-h period all examined groups showed similar variations in positive moods (figure 1), with nearly the same timing of maximum and minimal early morning values.

The two-factor analysis of variance with repeated measures revealed the significant main effects of groups of workers ($F(2,84) = 5.45$, $p < .01$) and time of day ($F(11,924) = 28.83$, $p < .001$). Additional analysis was performed to examine the differences in the positive mood rating levels between three groups. Pairwise comparisons showed that intolerant shiftworkers had a lower level of positive moods than both tolerant shiftworkers and non-shiftworkers (Scheffé, $p < .01$), while the differences between tolerant and non-shiftworkers were not significant.

There was no significant interaction between groups of workers and time of day ($F(22,924) = 0.98$, $p = .49$).

3.2. 24-h variations in negative moods
The average 24-h variations in negative moods obtained for the three groups of workers are shown in figure 2.

The two-factor ANOVA with repeated measures revealed the significant main effects of groups ($F(2,84) = 7.78$, $p < .01$) and time of day ($F(11,924) = 10.23$, $p < .001$). Pairwise comparison showed that both tolerant shiftworkers and non-shiftworkers were in a better (or 'less negative') mood than intolerant shiftworkers (Scheffé, $p < .01$).

There was the significant interaction of groups and time of day ($F(22,924) = 3.59$, $p < .001$). The interaction was examined further by analysing time-of-day effect for each
Figure 1. A plot of 24-hour variations in positive moods (mean ± SE)

Figure 2. A plot of 24-hour variations in negative moods (mean ± SE)

group. The analysis revealed the significant time-of-day effect in the groups of tolerant ($F(11,308) = 3.32, p < .01$) and intolerant shiftworkers ($F(11,308) = 9.68, p < .001$), while in non-shiftworkers the negative moods did not show significant variations over the 24-h period. The results in figure 2 indicate that non-shiftworkers had relatively the same ratings of negative moods over the 24-h period while the other two groups of workers showed more pronounced variations with maximum values in the early mornings.
3.3. 24-h variations in fatigue

The average 24-h variations in fatigue obtained for the three groups of workers are shown in figure 3.

The 24-h variations in fatigue showed the highly significant main effect of the time of day ($F(11,924) = 56.20$, $p < .001$) and effect of groups of workers ($F(2,84) = 8.43$, $p < .01$). Pairwise comparisons showed that intolerant shiftworkers were more fatigued than tolerant shiftworkers (Scheffé, $p < .01$) or non-shiftworkers (Scheffé, $p < .01$).

The interaction between groups of workers and time of day was not significant ($F(22,924) = 1.27$, $p = .18$).

4. Discussion

In this study an instrument for mood ratings containing a wide variety of adjectives was administered. Thus it was possible to provide an adequate description of the mood states. Factor analysis yielded three second-order factors of 24-h variations of mood labelled as positive moods, negative moods and fatigue. Factors of positive and negative moods can be viewed as two-mood dimensions denoting the positive and negative affective state. This evidence corresponds to the findings of Watson and Tellegen (1985) who, by reanalysing a number of studies of self-reported mood, indicated that positive and negative affects consistently emerged as the two major dimensions of mood. The third factor based on eight descriptors of fatigue can be viewed as an indicator of the functional state of the organism (Vukmirovic 1984).

Assessing the moods every 2 h seems to be the most appropriate way for detecting the 24-h variations in moods. When moods are assessed too often the subjects could become saturated and give incorrect answers and unreal mood ratings. On the other hand, fewer testing times cannot give a clear rhythm of the mood.

In this study, such criteria as sleep quality and psychosomatic-digestive complaints were used as indicators of the degree of tolerance to shiftwork. Results of many studies showed
that frequent problems related to shiftwork, and especially night-work, are those of sleep disturbance (Foret and Benoit 1977, Torsvall et al. 1981, Äkerstedt 1985) and the problems with digestion (Colligan et al. 1978, Costa et al. 1981, Vidaček et al. 1985, Segawa et al. 1987). According to Moore-Ede and Richardson (1985) the profile of specific health problems that can be identified as a characteristic ‘shift-work-induced syndrome’ include the disturbance of sleep-wake, gastrointestinal and cardiovascular systems.

The results obtained showed that workers who differed in the degree of tolerance to shiftwork differed in a level of 24-h variations in moods. The group of intolerant shiftworkers showed higher level of negative moods and lower level of positive moods over the 24-h period than tolerant and non-shiftworkers, i.e. tolerant shiftworkers and non-shiftworkers were in a better mood during the whole period. This finding was not surprising taking into account that tolerant shiftworkers and non-shiftworkers had a better quality of sleep and less psychosomatic-digestive complaints than intolerant shiftworkers, which probably reflects on their mood assessments. The better mood observed in these two groups speaks in favour of their generally better subjective well-being.

The feeling of fatigue in intolerant shiftworkers was significantly higher during the examined period than in the other two groups. This could be explained by a worse quality of sleep and a general feeling of unrest after waking, which caused these subjects to feel tired the whole day. Some researchers (Reinberg et al. 1981, 1984a,b) reported that intolerant shiftworkers, besides their problems with sleep and digestion, felt fatigue and an unusual irritation not attributed to physical or/and psychical strain. Since the feeling of ‘constant’ fatigue could produce certain objective changes in the organism, it could be used as a sensitive indicator of a decline of an individual’s functional state (Vidaček 1973). According to Reinberg and co-workers (1979), the subjective assessments of fatigue and related state could be a better indicator of (in)tolerance to shiftwork than some objective measures.

The only reliable interaction between groups of workers and time of day was observed for the negative moods. In a group of non-shiftworkers negative moods did not show a significant variation depending on the time of day, while in the other two groups the effect of time of day was significant. However, the differences between tolerant shiftworkers and non-shiftworkers occurred mostly during the night and early morning hours, when non-shiftworkers rated their negative moods at the same level as during the day and tolerant shiftworkers showed an increase. In comparison to these two groups, the rise in negative moods in intolerant shiftworkers had started already during the day and continued until the early morning hours. Thus, their intolerance to shiftwork besides the poor sleep quality and more psychosomatic-digestive complaints could be seen in high negative affective states evident throughout the whole day, such as anxiety, depression and hostility. This might result in the development or aggravation of some psychiatric disturbances and disorders (Koller et al. 1981).

To conclude, from the results obtained in this study it is obvious that the only consistent difference between the workers who differed in the degree of tolerance to shiftwork was the difference in the level of various moods. Generally, the workers intolerant to shiftwork were in a worse mood and more fatigued over the 24-h period than those who were tolerant to shiftwork or who never worked in shifts. Consistently higher levels of fatigue and negative moods could be viewed as a persistent state of unpleasant arousal and chronic fatigue and therefore, may be understood to be a warning preceding the occurrence of negative consequences to worker’s health and work capabilities.
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