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Still Healthy after Extended Work Hours? Ten Hours Shift, Twenty-one Days Working Period for Tunnel Workers

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Abstract: The aim of this study was to investigate self-reported health effects of extended work hours (10 h on/14 h off) for 21 d at work/21 d off, for 40 male tunnel workers in an Arctic area. A questionnaire obtaining information about demographics and subjective health complaints (SHC), including musculoskeletal, pseudoneurological, gastrointestinal, allergic, and flu-like complaints the last thirty days was distributed on day 14 of a work period. In addition questions on coping, psychological job demands, control, and social support were asked. The questionnaire was repeated three times during a nine months observation period. Twenty-six workers completed all three questionnaires. The prevalence of subjective health complaints did not change during the observation period. The prevalence of subjective health complaints was the same or lower than in a control group. There was a slight increase in self-reported job demands during the observation period. Coping, job control, and social support from colleagues and management were reported high and did not change. No association between this type of long work hours and changes in self-reported health was found in this study. However, this might have been a selected group of workers, and the same results may not be found in another population.

Key words: Health, Self-reports, Shift work, Work hours

Introduction

The number of shift workers, with work hours allocated outside standard work hours, has been increasing the past years. Today, about twenty percent of workers in Europe are employed with work schedules involving night work, and over five percent have extended work hours[1)]. Extended work hours can be defined as working more than 48 h a week[2)], but can also mean working shifts longer than eight hours[3)]. Shift work and extended work hours are also common in other parts of the world[4, 5)].

Both shift work and working extended hours may influence biological and social rhythms. This may cause negative health effects for individuals who have problems in adapting to irregular work hours, sleep, and rest[6)]. The relations between shift work and health problems are complex. Studies find that shift work, especially including night work, might be associated with social problems, coronary heart disease, mental health problems, sleep disturbances, and gastrointestinal problems[7)]. Other studies do not find consistent differences between shift workers and day workers with regard to health[8)]. Also, the effect of extended work hours on health and performance is not clear.

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Continuous work for long hours or long total work hours have been associated with objective and self rated health problems, sickness absences, and fatigue[9]. However, current scientific evidence is inadequate to give any firm recommendations about long work hours and health[10, 11].

Some occupational groups, for instance in construction work, may experience combinations of shift work and extended work hours[12], and the health effects from this combination are even less enlightened in the literature. No trend of decreasing physical performance[13] or changes in catabolic or anabolic metabolism[14] has been shown after a work schedule of twelve hours shifts, six work days, one day off and five work days in Denmark. However, longitudinal register studies of a special group of Danish construction workers with long distance between home and work place have shown increased risk of disability pension[15] and that these workers are treated more in hospitals[16]. A Swedish follow-up study of construction workers has shown increasing sleep problems, fatigue and pain[17]. As these results are not consistent, more knowledge of this topic is clearly needed.

The background for the present study was the need to construct a tunnel to transport coal from a coal mine to the nearest harbour in Svea, Spitsbergen (78° North). This is an isolated place where there are no other possible activities than work related to coal or transport, and the workers had to leave their homes and stay there to participate in this work. Both the employer and the employees in the construction company hired for this work wished to change their normal work schedule during this construction period. They did not want to spend their days off in Svea, but rather go home for longer periods. The workers wanted to spend 21 d at work in Svea followed by a 21-d free period. During the work period, the workers wanted to have either 21-day shifts or 21-night shifts, changing from day to night every other period. The dayshift was from 06:00 to 16:00 and the nightshift from 18:00 to 04:00. The Norwegian Labour Inspection Authority accepted this schedule provided that a medical evaluation and supervision took place during the work period in the project "Work hours in Svea". The project included repeated questionnaire studies on health and sleep, sleep diaries as well as objective measures of sleep by use of actigraphs and saliva samples of cortisol. The data concerning sleep are published elsewhere[18]. The parts of this evaluation which concern self-reported health are presented in the present study. Also the occurrence of work injuries is described.

The aim was to register subjective health among the workers by repeated measures during the observation period, to reveal possible changes. Self-reports (subjective health complaints, SHC) were chosen as a method to be able to register symptoms without extensive and hurting examinations. This method also made it possible to ask for the workers opinion about the work schedule. The hypothesis was that the workers health would experience more and more severe musculoskeletal, pseudoneurological and gastrointestinal symptoms after this type of work than they had before.

Subjects and Methods

Procedure

The workers were given a questionnaire three times during a nine months construction period. The study started a few weeks after the construction work began, due to practical reasons. Data were collected in April/May 2003 ("Svea 1"), in September/October 2003 ("Svea 2"), and in November/December 2003 ("Svea 3"). Half of the workers answered the first questionnaire during day-work, the second during night-work and the third during day-work. The other half of the workers answered the questionnaire during night-work, day-work, and night-work. Svea is in an Arctic area, and the first two questionnaires were answered during the light period of the year, the third during the dark period. Although the light conditions were different for these periods, they were similar for all the participants. Data were collected at day 14 in the work period at all three test sessions. Representatives from the research group were present at the first test session for all workers, and the participants were informed about the study. They returned the questionnaire in a sealed envelope to the company's office in Svea where members from the research group collected them after each test session.

Participants

All tunnel workers, 40 Norwegian men, answered the first questionnaire. Of these, 26 completed all three questionnaires. Of the 14 workers that did not complete the study, three workers left the company, three workers were transferred back to other tasks in the company, two persons were on sick leave, one worker lost his questionnaire and five workers refused to participate further in the study. New employees, replacing the ones who left, were not included.

Setting

The workers were organised in teams of 10–12 workers for each shift. They performed blasting and drilling of rock, loading, and transport of the blasted rock out of the work area, scaling, cleaning, rock bolting, and cement spraying, as well as maintenance of the equip-

ment and cars. The noise levels in the tunnel and in the cars were above 85 dB(A), and ear protection was needed. The dust levels varied, but due to ventilation in the tunnel, the levels of total dust were mostly below threshold limit values. Cement spraying was the dustiest work, and respiratory protective equipment was necessary. The tunnel itself was dark, but the blasting and drilling area were lit. Parts of the work were physically demanding, as they had to climb, crawl and work in different positions and with major use of hands and arms. They were all served the same type of food in a canteen, which was open also during the night-shift. Alcohol was not allowed at any occasion in Svea.

Questionnaire

Norwegian versions of questionnaires were used, and they included a set of background information about age, marital status, home address, years in the company, years of tunnel and shift work experience, and present smoking habits (yes/no). In addition, they were asked one question about "How will you describe your physical fitness?", answered on a five-point scale (Very good, good, medium, not good, bad), as this question also had been answered by the control group. They were also asked how much of their work time they performed repetitive movements, had their hands above shoulder level, and how often they lifted something heavier than 20 kg. In the third questionnaire, we also asked two questions about how the workers were satisfied with the shift schedule and whether they would like to have the same shift schedule again.

Subjective health complaints were measured with The Subjective Health Complaints Inventory (SHC)[19], 29 items concerning subjective somatic and psychological complaints experienced during the last 30 d, using a 4 point scale (0=no complaints, 1=some, 2=much, 3=severe complaints). Five subscales were computed; musculoskeletal pain (8 items: headache, neck pain, upper back pain, low back pain, arm pain, shoulder pain, migraine, and leg pain), pseudoneurological complaints (7 items: palpitation, heat flushes, sleep problems, tiredness, dizziness, anxiety, and depression), gastrointestinal complaints (7 items: heartburn, stomach discomfort, ulcer/non-ulcer dyspepsia, stomach pain, gas discomfort, diarrhoea, and constipation), allergy (5 items: asthma, breathing difficulties, eczema, allergy, and chest pain) and flu (2 items: colds/flu, cough).

Coping was measured by the Instrumental Mastery Oriented Coping factor[20], based on the Utrecht Coping list (UCL)[21]. IMOC (22 items) was based on three of the UCL scales "Active problem solving" (7 items), "Depressive reaction pattern" (7 items), and "Avoidance and passive expectancy" (8 items). Questions about how to cope with problems were scored on a four-point scale (1=seldom or never, 2=sometimes, 3=often, 4=very often). A high score is related to active problem solving and a low score is related to avoidance, passive expectancy and depressive reaction pattern. Questions on job demands, control and social support were asked to be able to evaluate changes in other work factors than the work schedule itself. Psychological demands were measured by five questions, control was measured by six questions, and social support by six questions, all from the short Swedish version of the Job Content Questionnaire[22]. The questions were scored on a 4-point scale, yielding three sum scores.

Control group

Data from a previous cross-sectional questionnaire study in a Norwegian normal population in 1996[23] regarding subjective health complaints and coping were available for the present study as a control group, for comparison at baseline of the study. The participants were randomly selected from the whole Norwegian population by the research company "Norwegian Gallup", and consisted originally of 1,255 persons. From this group, all working men, age 18–67 yr, were subtracted for our control group, giving a number of 449. Information was not available for the psychosocial parameters for this group.

Injuries

All injuries of the workers were reported by the workers to the management in the whole project period.

Statistics

Continuous variables were compared with Students *t*-test or by one way ANOVA in comparisons of three different sample points. Mann Whitney U-test was used for testing continuous variables with no normal distribution. Categorical values were compared by χ^2 tests. As the control group was slightly older than the tunnel workers, and smoked more, prevalence comparisons between these groups were performed by logistic regression analysis adjusted for age and smoking. SPSS for Windows version 15 was used for all statistic analyses, and significance level was set to 0.05.

Ethics

All participants gave their written consent to participate in the study. Ethical clearance was obtained from the Regional Committee for Medical Research Ethics in Western Norway. The investigation was conducted in co-operation with The Norwegian Labour Inspection Authority.

Results

The mean age of the participants was slightly lower among the workers from Svea than in the control group (Table 1). All workers in Svea lived in the main land of Norway, not on Spitsbergen. The work experience in the Svea group as a tunnel worker varied from 0 to 33 yr, mean 9 yr. Experience with shift work varied from 0 to 30 yr, mean 13 yr. Employment in the company varied from 0.5 to 24 yr, mean 4 yr. Fourty-five of the men described their physical fitness at baseline as very good or good, slightly more than in the control group (Table 1). Twenty percent of the men had periods with repetitive movements more than half of their work time and five percent worked with their hands above shoulder level more than half of their work time. Fourteen percent lifted something heavier than 20 kg more than 5 times daily. Information on physical fitness and physical work conditions was unchanged in the three different surveys.

No significant difference in prevalence of subjective health complaints was found for any of the scores, comparing the three Svea sessions (Table 2). The workers had lower prevalence for subjective health complaints on all symptom scores compared to the control group at all three sessions. Using logistic regression analyses, adjusting for age and smoking showed that the scores were very similar in the two groups (Table 2).

There were no significant differences in coping (IMOC) from the first to the last sampling comparing the scores from all three Svea questionnaires. The workers in Svea reported significantly lower depressive reaction patterns than the control group in all three comparisons (*t*-test, $p=0.02$), otherwise the results showed no differences between the groups.

There was a significant increase in experienced psychological demands from the first (Svea 1) to the last measurement (Svea 3) (Mann-Whitney U-test, $p=0.003$). There was no significant difference between the three questionnaires regarding the scales of job control or social support.

In the last questionnaire, 60 percent were very satisfied or satisfied with the shift schedule, 32 percent less satisfied and 8 percent dissatisfied. Twenty-three percent would like to have a similar work schedule again, 35% would not have a similar schedule again, and 42 percent did not have a specific meaning on this topic.

Fourteen workers in the baseline population did not answer all three questionnaires. Their baseline results were compared with the baseline results of rest of the study population (n=26). There were no differences in the prevalence of subjective health complaints.

Four injuries which needed attention by a physician were reported among the workers this year, one serious with costal fractures after a falling rock in the tunnel and three minor ankle or knee sprains after falling on ice.

Table 1. Background data for participants working in a special type of shift schedule at Svea, Svalbard and a control group

	Svea (n=26)	Control group (n=449)
Age – mean (SD)	40 (10)	43 (12)
Living with partner	75%	46%
Present smokers	34%	44%
Physical fitness		
Good/very good	45%	34%
Medium	44%	61%
Not good/bad	11%	5%

Discussion

The shift schedule used did not lead to any immediate negative health consequences among the tunnel workers. The prevalence of different subjective health complaints did not change during the work period, and

Table 2. Prevalence of subjective health complaints (percent answering 'yes' to minimum one of the symptoms in the scale) the past thirty days in Svea tunnel workers (n=26 males), obtained at three different times during one year, and a control group from the general Norwegian working population (n=449 males)

Symptom scales	Svea 1 %	Svea 2 %	Svea 3 %	Control group %	OR (95%CI) Comparing Svea 1 and the control group*
Musculoskeletal	70	59	53	76	OR=1.01 (0.99–1.03)
Pseudoneurologic	30	36	30	59	OR=0.78 (0.65–1.21)
Gastrointestinal	41	46	21	57	OR=1.00 (0.99–1.02)
Allergic	22	28	18	31	OR=1.01 (0.98–1.03)
Flu-like	41	41	49	52	OR=1.03 (1.01–1.05)

*Logistic regression, adjusting for age and smoking.

was at all times lower or the same as the level in the control group.

There are very few studies on similar extreme shift work situations. Studies have been performed on sleep among petroleum workers with twelve-hour shift work, showing high prevalence of shift work sleep disorder (SWSD). This study shows that workers with SWSD have more subjective health complaints than workers without. However, the present study has not information about SWSD, and similar comparisons cannot be performed[24]. However, a study of construction workers, working 84 h a week, with alternate weeks off, reported no difference in subjective health complaints compared to a control group working 40 h[18]. The study supports the findings in the present study that long and special work schedules do not necessarily lead to adverse health effects. These construction workers reported higher job control than a control group, not higher demands like in our study. However, the studies differed on many aspects regarding the work schedule, and are only partly comparable. In another study, two groups of construction workers were examined, one living in building-site camps, working extended hours (between 07:00 and 18:00) and extended workweeks six days in a row, one day off, five days in a row, nine days off. The other groups worked normal work days (08:00–16:00) and lived at home. The camp group reported higher fatigue scores than the home group, but the scores did not change during the two workweeks. This paper concludes that there is no real foundation for altering the camp group's current work schedule and living arrangements. On the other hand, another Swedish study[17] reports increased sleepiness, mental fatigue and pain among construction workers working double shifts (15.5 h) for one year. Eighty percent of these workers were long term commuters. It is difficult to understand why these results differ from the present study, but it might be due to the differences in the schedules. The workers in the Swedish study had only 8.5 h rest between the shifts, not 12 h rest like in our study.

Some Danish studies on construction workers also show conflicting results. Objective physiological tests[13] and tests of cortisol, testosterone and glycosylated haemoglobin[14] did not change after 12 h workdays. On the other hand a register study of construction workers[16] indicates that a subgroup with long hours and long work periods are treated more often in hospital than other construction workers. This might be an indication of increased morbidity in the group. However, the methodologies of these studies are different from the present one, and results are difficult to compare.

In our study the workers had 14 h of free time between the shifts. In the free time they had no social obligations. Sufficient time to recover between shifts can be a reason for their ability to cope with these extreme work hours. Sleep data from the same population show that their sleep was good, both while working day and night shift[18]. In addition the work period was followed by a 21 d free period at home, and that also gives opportunity of good restitution and might have been a contributing factor for how well the workers handled this work schedule.

The prevalence of subjective health complaints was lower or similar to the Norwegian general population and the other Nordic countries[25]. These findings indicate that the Svea workers were a special group from the beginning, and the presence of a "healthy worker effect" is suggested[8]. This is also supported by the fact that the Svea workers had different coping scores than the control group, and they also reported slightly better physical fitness. As we had no information on the physical workload in the control group, it is difficult to know if this factor was different in the two groups. Future studies on this topic should include workload in the analyses.

The number of reported injuries was low. The figures are very difficult to relate to the shift work or to compare with incidence in other studies. There are few studies of injuries in small working populations.

The workers themselves requested this particular work schedule. Svea is very isolated, and the workers did not feel any need for days "off" during the working period there, and the travel home was long and expensive. This is in accordance to a study by Di Milia, where shift workers rated leisure time higher than the negative effect of shift work such as sleep disturbances[26]. Financial benefits might also be a reason for wishing this particular shift schedule. Spitsbergen has lower taxes than the Norwegian mainland, and this was also the case for the workers when staying at Svea. In addition they had a relatively high salary. Although we did not see any health effects from this work, as many as forty percent of the workers reported that they were not really satisfied with the shift schedule, and 35 percent did explicitly say that they did not want this type of work schedule again. This probably means that there were other disadvantages related to the work than health problems. Other studies of tolerance to shift work have found that workers involvement in deciding the shift is of importance for reduction of problems related to this work. This did not seem to be enough for these workers, and maybe long-term use of this type of shift schedule must be performed with regular evaluations of the workers well being. The tunnel workers reported slightly increasing job demands in the work. This could of course be due to a factual harder work pressure, but

can also be a sign of their tiredness of the work situation, with long days and long periods away from home.

A limitation of the study is the small sample and the relatively short observation period. Longer periods with this kind of work might cause more problems than experienced here.

Also, the sample was reduced from 40 to 26 due to different causes. Some of the workers might have ended the work because of the shift schedule. However, this could only have been the case for a maximum of eight persons. Unfortunately we have no knowledge about the influence of the schedule for their leaving. What we know is that the ones who left did not differ from the others at base line, and did not seem to be especially vulnerable.

As the workers chose the schedule themselves, this could have caused underreporting of symptoms, as they may have wanted the schedule to be successful. Other, more objective examinations could have been chosen to reduce this weakness of the study. However, the self-reports were simple and easy to perform, mapping a large number of health problems without being too resourceful. Other studies have recommended this method for shift work evaluation[4]. The seasonal variation in lightening as in Spitsbergen did not appear to have any influence on the workers health. The Arctic light made day-work and night-work conditions similar in each work period. The last period was dark at all hours, while the first two periods were light at all hours, but despite this difference between the first and last survey, we found no changes in self-reported health.

In conclusion, the present study did not find any association between this type of extreme work schedule and self-reported health. However, this might have been a selected group of workers, and the same results may not be found in another population. The schedule was wanted by the workers. Also, the work period was restricted to nine months in time, and the workers had much time for rest and recovery. This might be two important factors to avoid health problems during this kind of work. Many of the workers would not have such a schedule again, indicating the need of carefulness when implementing these types of extreme work schedules.

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