Shift Work Disorder Among Oil Rig Workers in the North Sea

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Study Objectives: Shift work disorder (SWD) is a circadian rhythm sleep disorder caused by work hours during the usual sleep period. The main symptoms are excessive sleepiness and insomnia temporally associated with the working schedule. The aim of the present study was to examine SWD among shift workers in the North Sea.

Design and Participants: A total of 103 shift workers (2 weeks on 7 nights/ 7days, 12-h shifts, 4 weeks off), mean age 39.8 years, working at an oil rig in the North Sea responded to a questionnaire about SWD. They also completed the Pittsburgh Sleep Quality Index, Bergen Insomnia Scale, Epworth Sleepiness Scale, Composite Morningness Questionnaire, Subjective Health Complaint Inventory, Demand/Control, and Instrumental Mastery Oriented Coping (based on the Utrecht Coping list). Most of these instruments were administered during the first day of the 2-week working period, thus reflecting symptoms and complaints during the 4-week non-work period. The shift workers were also compared to day workers at the oil rig.

Results: Twenty-four individuals were classified as suffering from SWD, yielding a prevalence for SWD of 23.3%. During the 4-week non-work period, individuals with SWD reported significantly poorer sleep quality, as measured by the Pittsburgh Sleep Quality Index, and more subjective health complaints than individuals not having SWD. There were no differences between the 2 groups in sleepiness, insomnia, circadian preference, psychological demands, or control. Individuals with SWD reported significantly lower scores on coping. The reports of shift workers without SWD were similar to those of day workers regarding sleep, sleepiness, subjective health complaints, and coping.

Conclusions: The prevalence of SWD was relatively high among these shift workers. Individuals with SWD reported poorer sleep quality and more subjective health complaints in the non-work period than shift workers not having SWD.

Keywords: Shift work disorder, sleep, subjective health complaints

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SHIFT WORK, ESPECIALLY NIGHT SHIFT, DISRUPTS THE SLEEP-WAKE CYCLE AND ITS SYNCHRONY WITH THE BODY'S NATURAL BIOLOGICAL RHYTHMS.[1] SLEEP disturbances, impairment of work performance, disruptions in social and family life, stress, cardiovascular diseases, and gastrointestinal problems are all well documented to be related to shift work.[2] However, these problems are not uniform among shift workers, and there is limited knowledge why some individuals seem to tolerate shift work and others do not.[3] The mechanisms behind the association between shift work and poor health are complex and related to several biological, psychological, and social factors.[4] Night workers are required to be active when their bodily rhythms are preparing them for inactivity and sleep, and to sleep when their bodily rhythms are preparing them for activity and wakefulness.[5] The organization of the shift cycle, the coping strategies of the individual and the psychological demands and control over the work situation make important contributions to both social and health consequences of shift work.[4] Some workers tolerate shift work well; others do not.[6]

Shift work disorder (SWD)[7] represents a severe form of sleep disturbance observed with shift work, but there are few data available on this subject.[8] SWD is a circadian rhythm sleep disorder that is due to a work schedule which overlaps with the individual's habitual sleep period. The shift work schedule interrupts the normal sleeping pattern, causing sleep problems or lack of restorative sleep in vulnerable individuals. Symptoms include excessive sleepiness at night (the wake period) and insomnia during the day (the sleep period).[9] The diagnosis of SWD, defined by the International Classification of Sleep Disorders (ICSD-2),[7] is based on 4 criteria: (1) Complaint of insomnia or excessive sleepiness temporally associated with a recurring work schedule that overlaps the usual time for sleep, (2) symptoms must be associated with the shift work schedule over the course of at least one month, (3) circadian and sleep-time misalignment as demonstrated by sleep log or actigraphic monitoring for ≥ 7 days, and finally (4) sleep disturbance is not explainable by another sleep disorder, a medical or neurological disorder, mental disorder, medication use or substance use disorder.

Although many studies on shift work and its consequences have been carried out, studies on SWD as a specific disorder and of its prevalence and correlates are still sparse. It has been emphasized that it is important to make a distinction between shift workers with a sleep disorder independent of their shift work status and those in whom shift work is the essential component of their sleep disturbance.[9] The most commonly cited paper on SWD, reporting a prevalence rate of 10%, by Drake et al. did not specifically ask whether the workers had insomnia or excessive sleepiness associated to the work schedule. Instead Drake et al. compared the prevalence of insomnia and sleepi-

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Table 1—Comparison Between Shift Workers With or Without Shift Work Disorder (SWD) and Day Workers

	Shift workers with SWD (n = 24) (mean, SD)	Shift workers not having SWD (n = 79) (mean, SD)	Day Workers (n = 96) (mean, SD)
PSQI, global score	5.86 (2.73)	4.08 (2.84)*	4.49 (2.26)*
BIS, total score	8.96 (7.02)	6.79 (6.80)	7.70 (5.88)
ESS	7.30 (3.87)	6.34 (3.63)	7.06 (3.56)
CMQ	38.50 (4.79)	37.10 (6.01)	37.72 (4.95)
SHC, total score	12.65 (9.79)	5.81 (5.55)*	6.88 (4.83)*
Demands	2.46 (0.55)	2.64 (0.38)	2.51 (2.62)
Control	17.32 (2.72)	17.81 (2.09)	18.59 (2.07)*#
Coping	2.90 (0.27)	3.09 (0.22)*	3.14 (0.23)*

BIS, Bergen Insomnia Scale; CMQ, Composite Morningness Questionnaire; ESS, Epworth Sleepiness Scale; PSQI, Pittsburgh Sleep Quality Index; SHC, Subjective Health Complaints; SWD, shift work disorder; *P < 0.05, compared to shift workers with SWD. Post hoc LSD. #P < 0.05, compared to shift workers not having SWD. Post hoc LSD.

ness in night workers to day workers, and calculated a differential prevalence, that is, the prevalence of insomnia/sleepiness in night workers minus the prevalence among day workers.[9]

In the Norwegian offshore oil industry the workers live on sea-based oil platforms continuously during their work period, normally lasting for 14 days. Thus, during this period their sleep and adaptation to shift work is not disturbed by home and social obligations. This makes this shift work population especially interesting to study. The petroleum industry on oil platforms has a continuous production, and this creates a need of shift patterns including all hours. The most frequently used shift schedule in the offshore oil industry consists of 2 weeks of work followed by 4 weeks off work. The shift systems vary between "fixed" shift with either 12-h day shifts or 12-h night shifts during the 2-week work period or a "rollover" pattern, which means one week of night shift followed immediately by one week of day shift (also called swing shifts). The use of swing shifts has been debated in the oil industry, and is of particular interest, since during a 2-week work period the shift workers in the swing shift system adjust their sleep-wake rhythm twice, first at the beginning of the work period (getting adjusted to night work) and then in the middle of the work period (adjusting to day work).

The aim of the present study was to examine SWD among swing shift workers in the North Sea. The instrument used in this study was specifically designed to diagnose individuals with SWD in accordance with the criteria stated in the ICSD-2.[7] We also wanted to study whether individuals with SWD had sleep and health complaints during the non-work period, and whether there were differences in coping and/or psychological demands and control.

MATERIALS AND METHODS

Subjects

A total of 259 Norwegian oil rig workers working in the North Sea were recruited to participate in the study. These workers represented all employees in the operating oil company and all employees in one contractor company present at the particular oil rig in the North Sea. In all, 204 workers completed the questionnaires, yielding a response rate of 78.8%. Most questionnaires were filled out during the first workday at the oil rig, after a 4-week non-work period at home. Of the total sample 47.1% (n = 96) were working permanently day shift, 50.5% (n = 103) were working swing shift, 2% were working other schedules, and one subject did not report his work schedule. The focus in the present study was on subjects working swing shift (n = 103) and all these subjects were included in the present study, as one of the criteria of shift work disorder is working at ones usual time for sleep. Day shift workers can by definition not have SWD. To support this contention, none of the 96 day workers fitted the criteria for the SWD diagnosis based on the questions used in this study. Table 1 shows overall data for both shift workers and day workers. The swing shift workers (n = 103) worked 12-h night shifts from 19:00 to 07:00, the first week of the work period, followed by one week of 12-h day shift from 07:00 to 19:00. The last night shift before "swinging" ended at 04:00, and the first day shift started at 10:00 the same day. The study population (swing shift group) consisted of 98 males and 5 females, aged 19 to 59 years (mean 39.8, SD = 10.2 years). Shift work experience varied from 0.5 years to 37 years (mean 12.8, SD = 8.8). 97.1% of the subjects worked with either production or drilling.

Questionnaires

Demographic and Work Data (Administered First Day of Work Period)

A questionnaire consisting of demographic variables, working conditions, shift schedule, work experience, and sleep related problems was used to get descriptive data about the workers. In this questionnaire we included questions pertaining to the diagnosis of shift work disorder, see later.

Sleep (Administered First Day of Work Period)

Sleep during the 4-week non-work period was measured by the Pittsburgh Sleep Quality Index (PSQI). This instrument assesses quality of sleep and identifies sleep disorders during the last month.[10] The questionnaire consists of 19 self-rated questions yielding 7 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medications and daytime dysfunction. Each component is scored from 0 to 3, yielding a global PSQI score between 0 and

21. A PSQI global score > 5 is used as an indicator of sleep disorders, and differentiates between subjects who have sleep of good quality from those with poor quality.[10] The PSQI is validated in Norwegian with satisfactory validity and reliability.[11]

Insomnia during the 4-week non-work period was measured by the Bergen Insomnia Scale (BIS), consisting of 6 items adhering to criteria for insomnia stated in the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV, American Psychiatric Association, 2000) and conforming to clinical criteria for defining insomnia.[12] During the last month, how many days per week (0-7): (1) Did you spend more than 30 minutes to fall asleep after turning out the lights? (2) Did you wake up for more than 30 minutes during sleep? (3) Did you wake up more than 30 minutes earlier than you wanted, without being able to fall asleep again? (4) Have you not felt adequately rested following sleep? (5) Have you been so sleepy/tired that it has interfered with school/job or your private life? (6) Have you been dissatisfied with your sleep? A total score, ranging from 0 to 42 was calculated by adding the score of the 6 items.[13]

Sleepiness (Administered First Day of Work Period)

Sleepiness was measured by the Epworth Sleepiness Scale (ESS).[14] The ESS consists of 8 items that measure the subject's general tendency to sleep or doze of in 8 different situations. Each item is scored from 0 (no probability) to 3 (high probability), yielding a total score between 0 and 24. An ESS score above 10 is regarded as an indicator of excessive daytime sleepiness (EDS). The Norwegian translation of ESS has been validated.[15]

Circadian Preference (Administered First Day of Work Period)

Circadian preference was measured by the Composite Morningness Questionnaire (CMQ).[16] The questionnaire consists of 13 questions related to circadian rhythms. Each question is rated on a 4 or 5 point scale, rated from 1 to 4 or 5. Subjects obtaining a total score of 22 or less are considered as evening types, subjects with scores between 23 and 43 as intermediate types, and subjects obtaining scores of 44 and above as morning types.[16]

Subjective Health Complaints (Administered First Day of Work Period)

Subjective health complaints during the 4-week non-work period were measured by the Subjective Health Complaint Inventory (SHC).[17] The SHC consists of 29 items measuring subjective somatic and psychological complaints experienced within the last 30 days. The questionnaire has satisfactorily validity and reliability.[17] The instrument has 5 subscales: 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, diarrhea, and constipation), allergy (5 items: asthma, breathing difficulties, eczema, allergy, chest pain) and flu (2 items: colds/flu, cough). Severity of each complaint is rated on a 4-point scale (0 = no complaints, 1 = some, 2 = much, 3 = severe complaints). Each complaint is also scored for duration (number of days) during the last 30 days. Severity multiplied by days of duration has been used to obtain a total score indicating the degree of health complaints.

Psychological Demands and Control (Administered Last Day of Work Period)

Psychological demands were measured by 5 questions translated from the short Swedish version[18] of the psychological demands dimension from the demand/control model.[19] The questionnaire has satisfactorily validity and reliability.[20] Each question was scored along a 4-point scale, and all scores were added to calculate a composite score for psychological demands. High scores are related to working fast and hard, excessive work, insufficient time to work, or conflicting demands (high demands). Control was measured with 6 items from the short Swedish version[18] of the control dimension (decision latitude) from the demand/control model.[19] The items were scored along a 4-point scale, in which 4 questions refer to skill discretion and 2 questions refer to decision authority. High scores are indicative of high control/autonomy.

Coping (Administered Last Day of Work Period)

Coping was measured by the Instrumental Mastery Oriented Coping factor (IMOC) comprising 22 items from a condensed test battery (the CODE) based on the Utrecht Coping List (UCL).[21] The IMOC is based on 3 subscales of the UCL[22]: Active problem solving" (7 items), "Depressive reaction pattern" (7 items) and "Avoidance and passive expectancy" (8 items). The IMOC has satisfactorily validity and reliability[21] and questions about how to cope with problems are scored on a 4-point scale (1 = seldom or never, 2 = sometimes, 3 = often, 4 = very often). The scale reflects an instrumental, active, goal-oriented coping style with strategies such as direct intervention, considering different solutions to the problem and considering the problem to be a challenge.[21] High score on active problem solving together with low score on avoidance and passive expectancy and depressive reaction patterns indicates high instrumental oriented coping.[21]

Shift Work Disorder

Based on the minimal criteria from the ICSD-2,[7] 3 questions were specifically developed in order to make a diagnosis of SWD: (1) Do you experience either difficulties sleeping or experience excessive sleepiness? (yes or no), (2) Is the sleep or sleepiness problem related to the work schedule that makes you work when you normally would sleep? (yes or no), (3) Have you had this sleep or sleepiness problem related to the work schedule for at least one month? (yes or no). Subjects were classified as having SWD when they responded "yes" to all 3 questions. To study day time consequences of the disorder, one question was added: Does your sleep or sleepiness problem negatively affect social, family or work relations? (1 = not at all to 5 = very much). These questions were given during the first day of the work period, in the "Demographics and Work" questionnaire.

Table 2—Impact of Shift Work Disorder on Daytime Function

Does your sleep or sleepiness problem negatively affect social, family or work relations?	SWD diagnosis (n = 24)
1 not at all	n = 0
2 a little	n = 11
3 some	n = 9
4 a lot	n = 3
5 very much	n = 1

SWD, shift work disorder

Ethics

The study was approved by the Regional Ethics Committee of Western Norway (REK-West) and the Norwegian Social Data Service (NSD). The participants were informed that no information from the questionnaire would be given to the company, and that the company only would get access to anonymous results as presented in this publication. The workers returned their questionnaires in a sealed envelope to the medical nurse at the oil rig before they were sent to the researchers at the University of Bergen.

Analyses

SPSS 13.0 for Windows was used for the statistical analyses. Independent Samples T-test for continuous variables and chi-square tests for categorical variables were used to investigate differences between those with SWD and the non-SWD group. To investigate the risk of satisfying the criteria for sleep problems based upon a cut-off score of 5 on the PSQI, a logistic regression analyses was conducted (satisfying the criterion was coded "1" and not satisfying the criterion was coded "0"). To test differences between shift workers with or without SWD and day workers, a one-way analysis of variance (ANOVA) with post hoc least significance difference test (LSD) was performed. Significance levels were set at $P < 0.05$.

RESULTS

Demographics and Work

Of 103 swing shift workers (2 weeks on 7 nights/7days, 12-h shifts), 24 subjects were classified to have SWD. This gives a prevalence of SWD in this population of shift workers of 23.3%. The impact on daytime is presented in Table 2, showing that most workers with SWD reported a little or some negative consequence on social, family or work relations.

The SWD group and the non-SWD group were comparable according to age, shift work experience, work field, smoking, use of alcohol, and self-reported physical health. All in the SWD group were men, while there were 5 women in the non-SWD group (see Table 3). Of all respondents, 20.6% reported that they did not experience sleep problems related to work offshore. Not surprisingly, there were major differences between the SWD group and the non-SWD group on the overall sleep-related questions from "demographics and work" questionnaire (see Table 4).

Table 3—Demographics, Work History, and Life-Style in 103 Oil Rig Workers With Swing Shift, With and Without Shift Work Disorder (SWD)

	Non-SWD group	SWD group	P-value*
Gender (men)	93.7%	100%	0.210
Age in years	39.0	42.2	0.178
Work in production and drilling	96.2%	100%	0.547
Shift work experience (in years)	12.8	12.6	0.901
Smokers	32.9%	25%	0.215
Alcohol (units/14 days)	10.1	8.5	0.507
Physical health (good/very good)	88.6%	87.5%	0.917

*Independent samples *t*-test

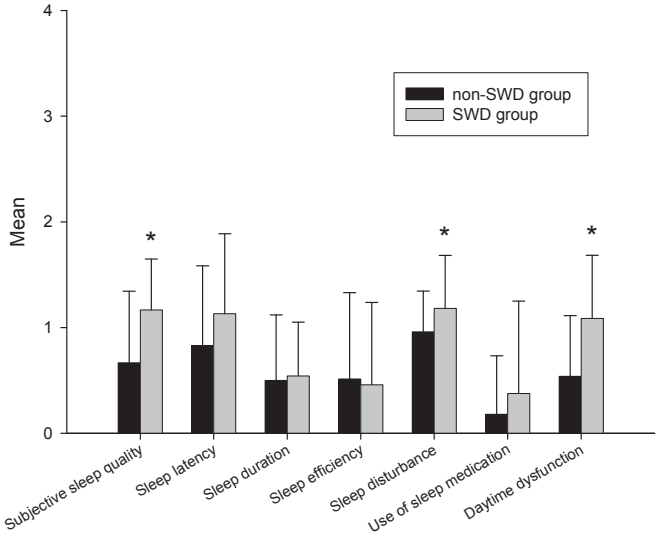

Figure 1—PSQI subscales in two groups of oil rig workers (n = 103) with swing shift, with and without shift work disorder (SWD). Data refer to the 4-week non-work period. *P < 0.05, Independent Samples t-test.

Sleep During the 4-Week Non-Work Period

There was a significant difference in PSQI global score between the SWD group and the non-SWD group (Table 1). For the 7 PSQI components, there were significant differences in subjective sleep quality ($P < 0.001$), sleep disturbance ($P = 0.03$), and daytime dysfunction ($P < 0.001$) between the 2 groups (Figure 1). In the SWD group, 41.7% (n = 10 of 24) had a PSQI global score > 5, compared to 22.8% (n = 18 of 79) in the non-SWD group. The odds ratio for scoring above cut-off on the PSQI, if the worker had SWD was not significant (OR = 2.50, 95% CI = 0.93 to 6.76).

There was no significant difference on the insomnia score (measured by BIS) between the SWD group and the non-SWD group (Tables 1 and 5). In the SWD group, 20.8% obtained a diagnosis of insomnia as defined by Lacks and Morin,[23] com-

Table 4—Subjective Reported Sleep Related Questions in 103 Oil Rig Workers With Swing Shift, With and Without Shift Work Disorder (SWD)

	All workers (n = 103)	Non-SWD group (n = 79)	SWD group (n = 24)	P-value*
Experienced sleep problems offshore	79.4%	73.1%	95.8%	0.003
Sufficient sleep in the non-work period	96.1%	96.2%	95.8%	1.000†
Sufficient sleep in the work period	65.0%	78.5%	20.8%	0.000
Sleep problems affecting work ability	34.0%	20.3%	79.2%	0.000†

*Chi-square test; †Fisher exact test is used when the expected count is less than 5.

pared with 15.2% in the non-SWD group. This difference was not significant.

Sleepiness During the 4-Week Non-Work Period

There was no significant difference in sleepiness measured by Epworth Sleepiness Scale between subjects with SWD and the non-SWD group (Table 1, P = 0.27). In the SWD group 8.7% (n = 2 of 24) had an ESS score > 10 compared with 14.3% (n = 11 of 79) in the non-SWD group. This difference was not significant.

Circadian Preference

There was no significant difference in diurnal type between subjects with SWD and the non-SWD group (Table 1, P = 0.30).

Subjective Health Complaints During the 4-Week Non-Work Period

The prevalence of subjective health complaints measured as ≥ 1 complaint during the last 30 days (during the non-work period) was 100% in the SWD group compared to 89.9% in the non-SWD group (P < 0.001). In all, 90.9% of those with SWD reported musculoskeletal pain compared to 69.6% of the non-SWD group (P = 0.04). A total of 87% of those with SWD reported pseudoneurological complaints, compared with 46.8% of the non-SWD group (P < 0.001). Of those with SWD, 87% reported gastrointestinal complaints compared with 50.6% of the non-SWD group (P < 0.01). The severity of subjective health complaints are presented in Tables 1 and 6.

Psychological Demands and Control Measured at the End of the Work Period

There were no significant differences between the two groups on psychological demands (Table 1, P = 0.080) or degree of control (Table 1, P = 0.373).

Coping Measured at the End of the Work Period

The SWD group scored significantly lower on coping (IMOC) than the non-SWD group (Table 1).

Comparison Between Shift Workers and Day Workers

Table 1 shows that shift workers without SWD were comparable to day workers on all parameters, except for control. Day workers reported higher degree of control than both shift worker groups.

DISCUSSION

In this group of shift workers the prevalence of SWD was 23.3%. Furthermore, during the 4-week non-work period, individuals with SWD reported poorer sleep quality, but not more insomnia or sleepiness than individuals not having SWD. Similarly, during the non-work period, individuals with SWD reported more subjective health complaints than individuals without SWD. The groups were similar concerning circadian preference. Concerning psychological demands and control there were no significant differences. However, the SWD group reported lower scores on coping than the non-SWD group. The non-SWD group reported similar sleep, sleepiness, subjective health complaints and coping as day workers.

There are few studies available on SWD. Drake et al. found that the overall "true prevalence" of SWD was 10.0% of shift workers from a community based population sample from 18 to 65 years.[9] This "true prevalence" was estimated by comparing the prevalence of insomnia and sleepiness in rotating/night workers (26.1% to 32.1%) to day workers (18%).[9] As stated in the review by Sack et al.[24] the formal diagnosis of SWD has rarely been used in research studies. We consider our study to be the first specifically designed to be able to diagnose individuals with SWD using the criteria stated in the International Classification of Sleep Disorders.[7] We asked the workers whether their insomnia and/or sleepiness problem were directly related to the work schedule. If our estimate is correct, a prevalence of SWD of 23.3% in our population is relatively high. The working conditions offshore with 12-hour shifts and 14-day work periods (7 nights in a row directly followed by 7 days in a row) may explain the higher prevalence.

SWD criteria include complaints either of insomnia or excessive sleepiness and should be associated with working hours in disagreement with regular sleep/wake patterns, which means working when one normally sleeps. In general, sleep disturbances are among the most reported negative health effects associated with shift work.[25,26] Insomnia and excessive sleepiness are also among the most commonly reported symptoms of patients with a variety of sleep disorders. It is therefore important to distinguish between shift workers with sleep disturbances independent of shift work, and shift workers with sleep disturbances caused by their shift schedule.[9] On one question asked about sleep problems related to offshore work, close to 80% of our total sample reported some to very much sleep problems,

Table 5—Bergen Insomnia Scale (BIS) in 103 Oil Rig Workers With Swing Shift, With and Without Shift Work Disorder (SWD). Data Refer to the 4-Week Non-Work Period

	Non-SWD group (SD)	SWD group (SD)	P-value
Spend more than 30 minutes to fall asleep after turning out the lights?*	1.33 (1.45)	1.61 (1.85)	0.455
Wake up for more than 30 minutes during sleep?*	1.31 (1.66)	1.17 (1.59)	0.726
Wake up more than 30 minutes earlier than you wanted, without being able to fall asleep again?*	1.29 (1.71)	1.83 (1.92)	0.205
Not felt adequately rested following sleep?*	1.26 (1.49)	1.78 (1.13)	0.124
Been so sleepy/tired that it has interfered with school/job or your private life?*	0.51 (1.04)	0.91 (1.08)	0.112
Been dissatisfied with your sleep?*	1.17 (1.63)	1.65 (1.65)	0.186

*Score from 0 to 7 days per week.

and 35% of the workers reported insufficient sleep in the work period. This means that many of the workers reported sleep problems related to offshore work, but only 23.3% fit the criteria for SWD.

Despite the high prevalence of SWD, most of the offshore workers in our sample did not report severe daytime consequences of their sleep or sleepiness problems. The question about daytime consequences was added to assess the clinical significance of SWD, even if this is not part of the diagnostic criteria.[7] Furthermore, it is important to point out that fewer consequences for social, family and work relations are expected in these offshore workers, since they live permanently on the oil rig during the whole working period.

The subjects in our study filled out sleep and health questionnaires the first day of the 2-week work period after a one month non-work period at home. The purpose was to examine symptoms and complaints during the 4-week non-work period. This may explain why there were no differences in insomnia and sleepiness between subjects with SWD and those not having this diagnosis. This strengthens the finding that the subjects in the study fit the diagnostic criteria for having SWD, a sleep disturbance related to the work schedule, and not a general sleep disturbance. In contrast to the lack of significant difference in insomnia and daytime sleepiness, the workers in the SWD group reported poorer sleep quality as measured by PSQI and more subjective health complaints as measured by SHC than the non-SWD group during the 4-week non-work period. The SWD group reported more musculoskeletal, pseudoneurological, and gastrointestinal complaints than the non-SWD group; and both groups reported a higher prevalence of subjective health complaints than other populations. Subjective health complaints are common in the general population.[27] At least 75% of a normal population has had at least one complaint during the last 30 days, from the musculoskeletal system, the gastrointestinal tract, the urogenital system, or pseudoneurological complaints, like fatigue, tiredness, dizziness, vertigo, and headaches.[17] Gastrointestinal complaints are commonly reported related to shift work and are explained by the derangement of normal eating habits, particularly on night shifts.[2] The high prevalence of subjective health complaints indicates that shift work may cause negative health, findings consistent with evidence in the literature,[28,29] and also found in an offshore population.[30] Our study, however, cannot say anything about causal associations. That is, SWD may cause poorer sleep quality and health complaints in the non-work period, but on the other hand, poor sleep quality and health complaints may be risk factors for developing SWD.

The SWD group also reported lower score on coping than the non-SWD group. Subjective health complaints have been related to physical as well as to psychosocial work factors and coping.[21,31] The cognitive activation theory of stress[32] offers a pathophysiological explanation why different physical, psychological, or psychosocial demands, or stressors, may affect physical health. The relationship between demands (or stressors) and health depends on individual coping mechanisms, defined as positive response outcome expectancy.[32] Coping in this study was measured by the Instrumental Mastery Oriented Coping factor (IMOC). This scale reflects an instrumental, active, goal-oriented coping style with strategies such as direct intervention, considering different solutions to the problem and considering the problem to be a challenge. Instrumental mastery-oriented coping has been shown to be negatively related to subjective health complaints.[21,31] This supports our findings and may explain the differences in subjective health complaints between the SWD group and the non-SWD group.

Some people seem to cope well with shift work, while others do not. It has been claimed that 1 of 5 workers leave shift work because they cannot tolerate it, 10% positively enjoy it, and the rest tolerate it to a greater and lesser extent.[6] The healthy worker effect has been a topic in shift work research.[33] Healthy shift workers continue as shift workers, and also self-select to shift work.[33,34] The offshore industry has strict regulations according to health and medication use. All employees are screened for health problems every other year, and in addition all use of drugs/medication is constantly controlled by the health personnel on the rig. It is therefore reasonable to assume that a healthy worker effect is present in our study. Despite this effect, we found a high prevalence of SWD, indicating that the diagnosis may be even higher in other populations.

It has been claimed that morning types have more difficulties adjusting their circadian rhythm to night work compared to evening types, and, in contrast, evening types will have more problems adjusting their rhythms to early morning shifts.[6] In our study we did not find differences between the 2 groups in terms of circadian preference.

Our study has several limitations. A novel and simple questionnaire was used for the diagnosis of SWD, relying on the worker's self-report. One may question the worker's attributions regarding the cause of the sleep and sleepiness problem.

Table 6—Severity of Subjective Health Complaints in 103 Oil Rig Workers With Swing Shift, With and Without Shift Work Disorder (SWD). Data Refer to the 4-Week Non-Work Period

	Non-SWD group (SD)	SWD group (SD)	P-value*
Musculoskeletal pain	2.18 (2.59)	4.82 (4.09)	**0.000**
Headache	0.40 (0.61)	0.82 (0.73)	**0.008**
Neck pain	0.38 (0.71)	0.83 (0.99)	**0.019**
Upper back pain	0.15 (0.49)	0.32 (0.65)	0.197
Lower back pain	0.48 (0.72)	0.95 (0.73)	**0.010**
Arm pain	0.28 (0.55)	0.57 (0.84)	0.057
Shoulder pain	0.32 (0.65)	0.68 (0.84)	**0.032**
Migraine	0.00 (0.00)	0.13 (0.34)	**0.001**
Leg pain	0.18 (0.45)	0.45 (0.97)	0.056
Pseudoneurology	1.19 (1.81)	3.22 (2.37)	**0.000**
Palpitation	0.08 (0.31)	0.04 (0.21)	0.639
Hot flushes	0.10 (0.30)	0.30 (0.56)	**0.024**
Sleep problems	0.33 (0.66)	1.14 (0.89)	**0.000**
Tiredness	0.42 (0.66)	1.23 (0.62)	**0.000**
Dizziness	0.08 (0.27)	0.13 (0.34)	0.423
Anxiety	0.08 (0.31)	0.13 (0.46)	0.511
Depression	0.11 (0.36)	0.35 (0.57)	**0.019**
Gastrointestinal complaints	1.37 (1.88)	2.54 (2.47)	**0.016**
Heartburn	0.27 (0.55)	0.55 (1.01)	0.094
Stomach discomfort	0.15 (0.46	0.30 (0.56)	0.183
Ulcer/Non-ulcer dys.	0.06 (0.33)	0.04 (0.21)	0.788
Stomach pain	0.20 (0.46)	0.35 (0.57)	0.213
Gas discomfort	0.40 (0.65)	0.65 (0.83)	0.136
Diarrhea	0.26 (0.50)	0.59 (0.59)	**0.010**
Obstipation	0.04 (0.25)	0.09 (0.42)	0.492
Allergy	0.52 (1.00)	1.26 (1.74)	**0.011**
Asthma	0.05 (0.27)	0.04 (0.21)	0.908
Breathing difficulties	0.01 (0.11)	0.17 (0.49)	**0.008**
Eczema	0.25 (0.54)	0.48 (0.85)	0.130
Allergy	0.18 (0.55)	0.35 (0.57)	0.197
Chest pain	0.03 (0.16)	0.22 (0.52)	**0.005**
Flu	0.57 (0.90)	1.04 (1.52)	0.062
Colds/flu	0.46 (0.68)	0.78 (0.95)	0.067
Cough	0.11 (0.32)	0.26 (0.69)	0.151

Numbers in bold represent $P < 0.05$; *Independent samples *t*-test

The questionnaire was not validated against objective measures of sleep and sleepiness. In a drug intervention study,[35] SWD subjects were included based on objective measures of sleep (sleep efficiency ≤ 87.5% on daytime polysomnography) and sleepiness (sleep onset latency ≤ 6 min on multiple sleep latency test). However, the criteria for SWD and for many other sleep disorders, including insomnia, other circadian rhythm sleep disorders, and restless legs syndrome, do not include such objective measures.[7]

Another limitation is that we did not specifically screen the subjects for other sleep disorders, medical or neurological disorders, mental disorders, medication use, or substance use disorder. However, the thorough health screening among these workers reduces the possibility to have such disorders or problems. People with major psychopathology and/or chronic severe diseases are not allowed to work offshore. Although the workers were not screened for sleep disorders, PSQI does include questions about snoring and breathing during sleep. The subjective health complaints questionnaire also covers many symptoms of different disorders/complaints, as shown in Table 5. Insomnia was not more prevalent among subjects with SWD during the non-work period, and 96% of the workers in both groups reported sufficient sleep during the non-work period (Table 4). The questionnaires were introduced the first day of the work period, and asked about symptoms and complaints during the last 4 weeks (i.e., non-work period). However, some workers may have misunderstood, and answered the questionnaires based on how they experience these symptoms while working.

Another limitation is that we did not include actigraphy or sleep log to identify subjects with SWD, even though this is one of the diagnostic criteria.[7] However, in a recent study by Schwartz and Roth,[8] the authors claim that SWD may be diagnosed by history alone, and actigraphy and sleep diaries can be useful for demonstrating a disrupted sleep/wake pattern and for formulating an intervention.

The statistical power in the present study was limited, given the relatively small number of observations. It is therefore only the relatively large group differences which were statistically significant. This implies that small but real group differences may have gone undetected. At the same time the significant group differences in the present study were of a substantial magnitude, preventing detection of group differences which may be of little practical and ecological importance.[36] Due to the limited statistical power, we decided not to correct for multiple comparisons. These statistical considerations need to be taken into consideration when evaluating the results. The different sleep related instruments (PSQI, BIS, ESS) may have multicollinearity. However the highest correlation coefficient between the scores of these instruments was 0.69 (between PSQI and BIS) representing less than 50% common variance. In addition, separate bivariate analyses (*t*-tests) were conducted for each instrument. Thus, multicollinearity should not represent a statistical problem in the current analyses.

Our findings are limited to swing shift workers, predominantly males, in one controlled shift work environment. The prevalence of SWD and the results found in our study population may not be generalized to different working conditions or to females. More studies on SWD are clearly warranted in various shift work populations. Lastly, we have no information about possible second jobs the workers may have during their 4-week non-work periods. Such extra jobs might influence the reported data.

In conclusion, we found a prevalence of 23.3% for shift work disorder among oil rig shift workers. Furthermore, during the 4-week non-work period, individuals with SWD reported poorer sleep quality and more subjective health complaints, but not more insomnia or sleepiness, than the individuals not having SWD. In addition, subjects with SWD reported lower coping than the non-SWD group.

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REFERENCES

1. Garbarino S, De Carli F, Nobili L, et al. Sleepiness and sleep disorders in shift workers: a study on a group of Italian police officers. Sleep 2002;25:648-53.
2. Costa G. The impact of shift and night work on health. Appl Ergon 1996; 27:9-16.
3. Axelsson J, Akerstedt T, Kecklund G, Lowden A. Tolerance to shift work-how does it relate to sleep and wakefulness? International archives of occupational and environmental health 2004;77:121-9.
4. Bogghild H, Jeppesen HJ. [Skiftende arbejdstider. Helbred og forebyggelse]. Månedsskrift for praktisk lægegerning 1995;5:679-89.
5. Smith CS, Robie C, Folkard S, et al. A process model of shiftwork and health. J Occup Health Psychol 1999;4:207-18.
6. Harrington JM. Health effects of shift work and extended hours of work. Occup Environ Med 2001;58:68-72.
7. American Academy of Sleep Medicine. International classification of sleep disorders, diagnostic and coding manual. Second ed. Westchester, IL: American Academy of Sleep Medicine; 2005.
8. Schwartz JR, Roth T. Shift work sleep disorder: burden of illness and approaches to management. Drugs 2006; 66:2357-70.
9. Drake CL, Roehrs T, Richardson G, Walsh JK, Roth T. Shift work sleep disorder: prevalence and consequences beyond that of symptomatic day workers. Sleep 2004; 27:1453-62.
10. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry research 1989;28:193-213.
11. Pallesen S, Nordhus IH, Omvik S, Sivertsen B, Matthiesen SB, Bjorvatn B. Pittsburg Sleep Quality Index (PSQI). Tidsskrift for Norsk Psykologforening 2005;42:714-7.
12. Lacks P, Morin CM. Recent advances in the assessment and treatment of insomnia. J Consult Clin Psychol 1992; 60:586-94.
13. Pallesen S, Bjorvatn B, Nordhus IH, Sivertsen B, Hjørnevik M, Morin CM. A new scale for measuring insomnia: The Bergen Insomnia Scale. Percept Mot Skills 2008;107:691-706.
14. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14:540-45.
15. Pallesen S, Nordhus IH, Omvik S, Sivertsen B, Tell GS, Bjorvatn B. Prevalence and risk factors of subjective sleepiness in the general adult population. Sleep 2007;30:619-24.
16. Smith CS, Reilly C, Midkiff K. Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of morningness. J Appl Psychol 1989;74:728-38.
17. Eriksen HR, Ihlebaek C, Ursin H. A scoring system for subjective health complaints (SHC). Scand J Public Health 1999;27:63-72.
18. Theorell T, Michelsen H, Nordemar R. [Validitetsprövning av psykososiala indexbildningar] Validity testing of psychosocial indices. In: Hagberg M HC, editor. [Stockholmsundersökningen 1] The Stockholm Study 1. Stockholm: Music Books; 1993:163-77.
19. Karasek R, Theorell T. Healthy work. Stress, productivity, and the reconstruction of working life. 1990. New York: Basic books, Inc., Publishers.
20. Theorell T, Perski A, Akerstedt T, et al. Changes in job strain in relation to changes in physiological state. A longitudinal study. Scand J Work Environ Health 1988;14:189-96.
21. Eriksen HR, Olff M, Ursin H. The CODE: A revised battery for coping and defense and its relations to subjective health. Scand J Psychol 1997;38:175-82.
22. Schreurs PJG, Tellegen B, van De Willige G, Brosschot JF. De Utrechtse. Coping Lijst: Handleiding. 1988. Lisse, Swets en Zeitlinger.
23. Lacks P, Morin CM. Recent advances in the assessment and treatment of insomnia. J Consult Clin Psychol 1992;60:586-94.
24. Sack RL, Auckley D, Auger RR, et al. Circadian rhythm sleep disorders: part I, basic principles, shift work and jet lag disorders. An American Academy of Sleep Medicine review. Sleep 2007;30:1460-83.
25. Akerstedt T. Shift work and disturbed sleep/wakefulness. Sleep Med Rev 1998; 2:117-28.
26. Akerstedt T. Shift work and disturbed sleep/wakefulness. Occup Med (Lond) 2003; 53:89-94.
27. Eriksen HR, Svendsrod R, Ursin G, Ursin H. Prevalence or subjective health complaints in the Nordic European countries in 1993. Eur J Public Health 1998;8:294-8.
28. Costa G. Shift work and occupational medicine: an overview. Occup Med (Lond) 2003;53:83-8.
29. Knutsson A. Health disorders of shift workers. Occup Med (Lond) 2003;53:103-8.
30. Parkes KR. Shiftwork, job type, and the work environment as joint predictors of health-related outcomes. J Occup Health Psychol 1999;4:256-68.
31. Eriksen HR, Ursin H. Subjective health complaints: is coping more important than control? Work Stress 1999;13:238-52.
32. Ursin H, Eriksen HR. The cognitive activation theory of stress. Psychoneuroendocrinology 2004; 29:567-92.
33. Knutsson A, Akerstedt T. The healthy-worker effect - self-selection among Swedish shift workers. Work Stress 1992;6:163-67.
34. Wedderburn A. Shiftwork and Health. 1/2000. BEST. Published by the European Foundation for the Improvement of Living and Working Conditions. Ref Type: Report
35. Czeisler CA, Walsh JK, Roth T, et al. Modafinil for excessive sleepiness associated with shift-work sleep disorder. N Engl J Med 2005;353:476-86.
36. Cohen J. A power primer. Psychol Bull 1992;112:155-59.