CHAPTER 1

General introduction
Nonstandard working hours

The 40-hour working week

Amidst the industrial revolution at the beginning of the 19th century, Robert Owen, a Welsh social reformer, started a radical campaign for “Eight hours labour, eight hours recreation, eight hours rest”. Owen argued that this working schedule would be better for the happiness, motivation, and health of employees, rather than the 10-16 hour working days, six days a week that factory employees were required to work for maximum financial gain (1,2). Dividing the day into three equally long periods—one for work, one for leisure, and one for sleep—introduced the concern for workers’ health and well-being and the idea that these could be enhanced by time off for rest and recreation.

However, Owen’s ideas were not very popular amongst factory owners and it was not until the first half of the 20th century that many industrialised countries caught on to his ideas (3). In 1921, the International Labour Organisation (ILO) passed a convention for weekly rest breaks for industry (4). In 1935, this was followed by a convention for a five-day 40-hour working week (5). As recently as 1993 the first European Commission (EC) Working Time Directive was accepted that protected workers’ rights and that included limits to weekly working hours (48 hours including overtime) and minimum durations of rest periods (11 consecutive hours between working days and 35 consecutive hours per seven-day period) (6).

Defining nonstandard working hours

Although the 40-hour working week has become the norm, nonstandard working hours are still common in European. Of the workers, an estimated 21% work in shifts and 19% work at night (7). At least once a month, 32% of the workers report working >10 hours per day. Twelve percent regularly work >48 hours per week; in some sectors this percentage is higher, for example in manufacturing (20%) and the service sector (15%) (7,8). Further, an estimated 30% of the workers regularly work on Sundays (7).

In this dissertation, nonstandard working hours encompass a broad definition: i.e. any form of working hours outside of the 40-hour working week of five 8-hour days. This includes extended working hours (≥9 hours per day), extended working weeks (>5 days per week), weekend work, on-call duties, shift work, night work, as well as any combination of these working hours. Shift work is described as any working time arrangement that requires working regularly at times between 6pm-6am; this includes evening work, night work, and early morning work (9). Night work refers to at least 3 hours spent working between 10pm-6am (10).
Health effects of extended working hours and extended working weeks

Since the acceptance of the 40-hour working week, research has supported that extended working hours and extended working weeks can be detrimental to health. Such working hours are associated with fatigue in the short term and cardiovascular disease in the long term (11-15). The health problems are hypothesised to be caused by the short leisure time between working days, which may not be sufficient to relax and unwind, and to fully recover from the daily efforts expended at work (16). According to recovery theory, the accumulation of fatigue over time may lead to wear and tear of the body’s physiological functions, which may in turn lead to ill health (17,18).

Health effects of shift work

The EC Working Time Directive limits night time working hours to an average of 8 hours to reduce any health damages associated with night work (19). Although findings are not always consistent, night work and shift schedules that include night work have been associated with sleepiness, need for recovery, and fatigue in the short term and cancer, cardiovascular disease, gastrointestinal disease, and diabetes in the long term (20-26). The main hypothesis explaining these health problems is a disruption to the body’s circadian rhythm. This rhythm is a complex physiological process that, under normal circumstances, keeps us awake during the day and asleep at night. Disruptions are caused by being awake and active at night when the body should be resting and sleeping (27). This may lead to short-term health symptoms, while repeated night work may lead to long-term health problems (28-31). Next to disruptions to the circadian rhythm, a lack of recovery between shifts has also been suggested to cause health complaints in shift workers (32).

Health effects of combining shift work with extended hours and extended weeks

Shift workers have shown preference for schedules with extended working hours and extended working weeks, because they provide extended free periods (33). However, the long-term health effects associated with such schedules are unknown. The question is whether combining these working hour characteristics may lead to an exacerbation of the health effects related to extended working hours, extended working weeks, and shift work. The question is also whether the extended free periods provide sufficient time to recover in order to maintain employee health.

Recovery theory

Both research on extended day work and research on shift work acknowledge that recovery between working days and working periods is important for employee health maintenance (16-18,34). The Effort-Recovery Model defines recovery as a return to and stabilisation of psychophysiological systems at their baseline level of activation in the absence of specific
demands (16). When performing work tasks, psychophysiological activation increases; after work, recovery reverses this process (18). However, when activation is sustained after work, it can over time cause wear and tear on the body and lead to health problems (17). Indeed, inadequate recovery after work has been associated with health problems, including cardiovascular disease, fatigue, and sleep problems (35-37).

Recovery is influenced by activities pursued by employees during their leisure time. For example, sports and physical activity keenly promote recovery, and so may social activities (38). Conversely, continued negative thoughts and worries about work, as well as work-related activities, may sustain activation and thereby impede recovery (37,38).

Recovery has mostly been studied as a static concept, for example by assessing the ‘need for recovery’ in cross-sectional studies; however, it is a dynamic process that unfolds over time (39). Zijlstra et al. (39) proposed it is a process of energy regulation relative to the regular circadian rhythm. At work, an employee may need to muster additional effort to perform tasks; while after work, an employee may need to down regulate his/her energy level in order to align it with the regular circadian rhythm. In extended working hours, extra effort may be mustered to continue performing work tasks when the employee is getting tired and the circadian rhythm is at a state of reduced energy.

An extreme case of energy regulation takes place when working at night (39). At night the body’s energy levels are low and ready for a good night’s sleep, but in order to stay awake and to perform work tasks, an increased effort is needed on the part of the night worker. Indeed, shift work has been associated with an increased ‘need for recovery’ (22). After working at night, free periods should provide the opportunity to recover.

This dissertation

Long working hours and shift work in the offshore petroleum industry

Derogations may be made from the EC Working Time Directive regulations in the case of offshore work, where extended working hours, extended working weeks, and night work are standard (19,20,41). In Norway, the petroleum sector forms the country’s largest industry sector, contributing significantly to national export (49% in 2014), the welfare state, and the labour market (42-44). An estimated 6% of the Norwegian labour force works directly in the petroleum industry, with an additional 4% working indirectly in it (44,45). Approximately 29,000 people (1% of the Norwegian labour force) are employed on offshore petroleum installations (45,46). This sizable contribution of the petroleum sector to the Norwegian economy
and labour market indicates the importance of ensuring the productivity, health, and safety of its employees.

The remote locations of the oil platforms necessitate compressing the working hours into 12-hour shifts and extending the working period to 14-21 days. Normal working hours are from 7am-7pm for day work and 7pm-7am for night work. Within the offshore population, shift schedules consist of permanent day work (47.3%); permanent night work (2.2%); fixed shifts, i.e. alternating day and night shifts every other tour (6.3%); or swing shifts (25.6%), i.e. either 7 day shifts followed by 7 night shifts every tour or vice versa (46). For the remainder of the population, the schedule varies (17.7%) or other schedules are worked (1%) (46). This suggests that approximately half (51.8%) of the offshore population at some time works at night, and that a third (34.1%) regularly—every tour or every other offshore tour—works at night.

On offshore installations a diversity of jobs is found, such as platform managers, control room operators, administrative staff, process engineers, drillers, maintenance staff, divers, and hotel and catering staff (47). Between these jobs, task demands vary; for example platform managers and control room operators have predominantly cognitive task demands, while maintenance staff, divers, and hotel and catering staff predominantly have physical task demands (33). All offshore personnel require a safety course certificate and a health certificate to safely work offshore (48). Meals are catered for and hotel facilities provide laundry and room-cleaning services (49).

Recovery from offshore work

The extended working hours and working weeks of offshore schedules may impede the recovery process by providing too little time between shifts for recovery. This may lead to an accumulation of fatigue over the working period and a spill-over of the level of fatigue into the start of the free period (11,12). Recovering from night shifts in these schedules may be extra challenging, as the opportunity to recover between shifts is further impeded by sleep problems and disruption of the physiological circadian rhythm associated with the changed sleep/wake cycle (27,50-52).

Following an offshore tour, 21-28 days of respite is given that should give ample opportunity to unwind and recover from the offshore working period, as well as the opportunity to pursue leisure time activities—activities that ideally promote recovery (38,41). However, the offshore worker may return to a family and social life where they expected to participate in household chores and social gatherings; this may be taxing for the employee (53). Therefore, although the free period is long and may seem to provide ample time to recover and pursue leisure time activities, no evidence exists to support whether this actually is the case.
Main aims of this dissertation

The health effects of schedules that combine extended working hours and extended working weeks with shift work, such as in the offshore industry, have received little scientific attention. The health effects of such schedules, therefore, remain speculative. Recovery, as a short-term health outcome, could shed light on the effects of combining these schedule characteristics; thereby contributing to schedule optimisation. Additionally, studying the recovery process after shift work will help understand how and why working hours can affect health. Therefore, the overall aim of the dissertation was to obtain insight into the theoretical and empirical association between nonstandard working schedules (in particular offshore type schedules), recovery, and health.

For this purpose, the dissertation was divided into four central aims:

AIM 1 To develop a comprehensive model on the relationship between nonstandard working schedules and health-related outcomes in schedules that combine extended hours and weeks with shift work, and to identify the role that recovery plays in this relationship.

AIM 2 To investigate the associations between shift work and proxies for health.

AIM 3 To study the course of recovery after 2-week 12-hour offshore working periods that consisted of schedules of night work and day work.

AIM 4 To describe the activities offshore employees pursue during their free period that are expected to influence recovery.

Outline of the dissertation

AIM 1 is addressed in Chapter 2 that illustrates the development of a model on the association between nonstandard working hours and health, in which extended working hours, extended working weeks, shift work, and recovery play a central role. To address AIM 2, Chapters 3 and 4 describe systematic literature reviews on the association between shift work and sick leave, and between shift work and body weight change, respectively. To address AIM 3, Chapter 5 presents the course of subjectively assessed recovery for 14 days and Chapter 6 describes the course of physiological recovery for 11 days following an offshore working period. AIM 4 is addressed in Chapter 7 that describes the activities that offshore workers pursue during the first 14 days of their free period.
Definitions used in this dissertation

In this dissertation the following definitions are used:

**Nonstandard working schedule:** any form of working hours outside of the 40-hour working week of five 8-hour days

**Shift work:** regular employment outside the hours of 6am-6pm; this includes evening work, night work, and early morning work

**Night work:** at least 3 hours of duty spent working between 10pm-6am

**Extended working hours:** ≥9 hours per day or ≥48h per week; this does not include overtime

**Extended working weeks:** >5 days per week

**On-call duties:** any schedule in which an employee is available for work during a predefined period and can be called in to work at any time during this period. The employee does not necessarily work all these hours, but he/she is expected to work whenever it is required
References


Steinmetz H, Schmidt P. Subjective health and its relationship with working time variables and job stressors: sequence or general factor model? Work Stress 2010;24(2):159–78.


Zijlstra FR, Cropley M, Rydstedt LW. From recovery to regulation: an attempt to reconceptualize ‘recovery from work.’ Stress Health 2014;30(3):244-52.


Krohne K, Magnussen LH. Go to work or report sick? A focus group study on decisions of sickness presence among offshore catering section workers. BMC Res Notes 2011;4:70


