Psychosocial aspects of work and health in the North Sea oil and gas industry

Summaries of reports published, 1996 - 2001

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Psychosocial aspects of work and health in the North Sea oil and gas industry

Summaries of reports published 1996 - 2001

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This document brings together summaries and key findings from a series of nine studies carried out by the University of Oxford with funding from the HSE Offshore Safety Division, and published during the years 1996 - 2001 under the general title *"Psychosocial aspects of work and health in the North Sea oil and gas industry"*. The work covers a range of topics relating to offshore work characteristics, mental and physical health among offshore personnel, and safety attitudes and perceptions (including an analysis of accident/injury statistics); the role of demographic factors, individual differences, and environmental characteristics in influencing work/health relationships is also considered. Offshore shift schedules, and their impact on performance, health, and safety, is a major issue cutting across several of the studies summarised. A bibliography of offshore research, including details of all the reports summarised, is also provided.

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FOREWORD

The North Sea work environment has undergone considerable change in recent years, and the effects of organizational restructuring, cost reduction, and technological innovation will continue to impact on the oil and gas industry in the future. In these changing circumstances, the health, safety, and productivity of the North Sea workforce is an issue of concern not only to personnel working offshore, but also to onshore management teams and the industry as a whole.

In this context, there is a need for up-to-date information about work and health in the offshore environment. The research summarised in this document was carried out by Oxford University between 1995 and 2000 with funding from the Health and Safety Executive, Offshore Safety Division, under the general title *'Psychosocial aspects of work and health in the North Sea oil and gas industry'*. The work sought to contribute to several research areas of topical importance in the offshore oil and gas industry. The main survey data collection took place during 1995-1996, with additional studies carried out subsequently. This summary document brings together summaries and key findings from a total of eight completed studies (each of which have been fully described in separate reports published by HSE Books). In addition, a preview of results from the five-year offshore follow-up study undertaken in 2000 is presented. Full references to the reports, and a bibliography of other relevant research, are also included.

The research described would not have been possible without the high degree of co-operation received from the operating companies concerned, and the encouragement of the United Kingdom Offshore Operators Association. In providing an up-to-date account of work, health, and safety among offshore personnel, it is hoped that the research will be of interest not only to the participating companies but also to the oil and gas industry more generally, and will serve to promote greater awareness of the importance of human factors research at a time of rapid change in the industry as a whole.

1. INTRODUCTION

Offshore oil and gas production, and the exploration and drilling operations that support it, play a significant role in the UK economy, and employ a substantial workforce. Although numbers fluctuate from year to year, over recent years the North Sea workforce has averaged more than 30,000 personnel. The nature of the offshore environment is such that the personnel concerned are exposed to work demands and constraints over and above those experienced in comparable jobs onshore.

The psychosocial stressors inherent in offshore employment include the remote and isolated location of many North Sea installations; adverse weather conditions and physical environment; confined work and living conditions; lack of privacy; the perceived hazards of offshore work and the helicopter travel that it necessitates; demanding shift patterns and, in some cases, monotonous or repetitive work; separation from family and local community; and possible family problems arising from intermittent absence from home.

In view of the demanding lifestyle of offshore employees, it is not surprising that the offshore work environment, and the combination of physical and psychosocial stressors that it imposes, has been the subject of considerable research interest over the past two decades. Although the study carried out by Hellesøy (1985) in the Norwegian *Statfjord Field* is probably the most wide-ranging of the earlier research into North Sea work conditions, other investigators from both medical and psychological backgrounds have also contributed to this field of research.

Most of these studies have focused on specific aspects of the offshore environment. For instance, Lauridsen *et al*. (1991) reported a large-scale survey of offshore shift patterns and their health implications; Gann *et al*. (1990) focused on anxiety and depression among onshore and offshore employees of a multi-national oil company; Horsley and MacKenzie (1996) surveyed lifestyle and health behaviours; and Iversen (1991) examined predictors of sickness absence among offshore personnel. Other studies have highlighted safety issues; for instance, Rundmo (1992) and Flin *et al*. (1995) assessed perceived risk among North Sea personnel, while Sutherland and Cooper (1991) investigated the role of personality factors in relation to self-reported accident involvement in an offshore sample.

An alternative research approach is to focus on particular occupational groups within the offshore workforce. Thus, Flin and Slaven (1992) examined the background and experience of offshore installation managers; Parkes (1992, 1993) compared onshore and offshore production personnel on a range of psychosocial factors; and Milcarek (1993) reported a longitudinal analysis of job tenure and turnover among offshore catering personnel.

These studies, and other literature relating to health and safety among offshore personnel, have recently been reviewed by Parkes (1996), and are therefore not discussed in detail here. Nonetheless, it is clear that a considerable amount of research has already been carried out into the work conditions and well-being of offshore personnel, and it is therefore important to clarify, in the light of this previous work, the particular contribution that the present study seeks to make.

In part, the rationale for the present series of studies lies in the nature and extent of changes that have taken place in the North Sea oil and gas industry in recent years. Few of the studies cited above are based on data collected sufficiently recently to reflect these changes. In particular, the Cullen report (Cullen, 1990) has led to significant improvements in offshore safety regimes during recent years, involving modifications to structures, procedures, and regulations, and a formal requirement for operating companies to produce detailed 'safety cases'.

Other recent and significant changes in the North Sea work environment are also relevant. Thus, fluctuations in oil prices, and falling production levels in older oil and gas fields, have necessitated the progressive introduction of cost-reduction measures, including widespread down-manning (particularly on older platforms) and associated job insecurity during the past decade. Correspondingly greater efficiency and flexibility, in terms of the amount and variety of work carried out, have been demanded of the remaining workforce; on some installations, also, the duration of offshore tours has been extended in a further attempt to reduce costs. Moreover, installations built and commissioned over the past few years tend to be relatively small, and to operate with higher levels of automation and fewer personnel than those of earlier generations, a trend likely to continue in the development of new structures.

In the light of these changes, earlier studies (particularly those based on data collected in the 1980's and early 1990's) do not adequately reflect the current offshore work environment. Furthermore, the series of studies summarised in this document, seek to provide both a wide-ranging overview of psychosocial factors, health and safety in the North Sea work environment and more detailed consideration of topics (including shift rotation schedules and work/leave patterns) of more specific relevance.

Thus, the rationale for the programme of work described here lies in the need for up-to-date information about offshore work conditions, and their health and safety implications. The studies summarised in this document were designed to meet this need, and to address some of the methodological limitations of earlier work. The work outlined includes:

- A general review of psychosocial aspects of work and health in the North Sea oil and gas industry covering work published up to 1996.

- A large-scale survey (carried out in 1995-6) of psychosocial aspects of the offshore work environment in relation to a range of health and safety outcomes.

- A detailed investigation of the effects of different patterns of shift rotation (comparing those which do, or do not, impose a mid-tour day/night shift change) on sleep, mood and performance measured repeatedly across the two-week offshore work cycle.

- A review of relevant literature and data which address the issue of 3-3 working (as compared with the more usual 2-2 work/leave cycles), with particular reference to the attitudes of offshore personnel and their spouses to the longer work/leave cycle.

- Analyses based on archival data relating to offshore accidents and injuries, focussing on the effects of length of tour and hours into shift in relation to accident severity.

- An analysis of the frequency and nature of sickbay consultations in relation to personal and job-related factors, including age, job type, job level and shift work.

- Drawing on findings from a parallel survey of onshore oil and gas processing sites, a comparison of offshore and onshore environments, and their impact on health and safety.

- A pre-view of findings from a five-years follow-up study of the 1995-6 survey participants.

A final section reviews some central issues arising from the programme of work as a whole, and notes areas in which further research is needed.

2. REPORT SUMMARIES

Part I. A review of the literature

K. R. Parkes

2.1.1 Summary

This report reviews the literature on psychosocial factors and health (particularly psychological health) among offshore personnel. The material (which covers publications that appeared prior to 1996) is divided into five main sections: general patterns of health and illness on offshore installations as reflected in records of medical evacuations, sickbay visits, and sickness absence; psychosomatic complaints and minor health impairment; health problems associated with shift rotation; mental health, stress and psychosocial factors; and health behaviours and lifestyle.

The material reviewed is based largely on English-language documents originating in the United Kingdom or Norway; sources include articles from the psychological and medical literature, research reports, and conference papers. The review does not seek to cover specialist medical topics; rather, it seeks to integrate the available literature from a health psychology perspective. A final section highlights problems of interpreting research findings, and identifies some work conditions and health issues of current concern to the North Sea workforce.

2.1.2 Key findings

Considerable research effort has been devoted to understanding the physical and psychosocial environment of North Sea oil and gas installations, and its implications for job satisfaction and health. A number of important issues are highlighted in this review, although the available literature (1979-1996) does not allow causal links between the work environment and health to be clearly identified.

Age. Figure 1 (taken from the 1995-6 survey report) shows the current marked predominance of oil industry personnel in the 40–50 years age range, and the correspondingly small proportion of personnel under 25 years. The increasing age profile of offshore workers is of concern to the industry, but research reveals both positive and negative findings. Thus, older personnel tend to report fewer health problems (although more sleep disturbance), and to make fewer visits the sickbay. However, they are more likely to require medical evacuation because of illness (but not accidents) than their younger counterparts.

Anxiety. Offshore personnel (particularly those in the older age ranges) tend to report higher levels of generalised anxiety symptoms than comparable employees onshore. The favourable personality traits of offshore personnel, and the high health standards demanded, suggest that environmental factors may underlie the anxiety observed.

Health risk. Among offshore personnel, body mass index (a measure of weight relative to height) has been found to be higher than among comparable onshore employees. Moreover, offshore diets tend to be high in fat and protein, and low in carbohydrates. Rates of smoking also tend to be high. These factors are associated with cardiovascular risk. To reduce these problems, health promotion and other '*lifestyle*' programs, have been introduced by some offshore companies.

Environment. In the offshore environment, installation characteristics (e.g. age, location, size and type), physical environment (e.g. noise, ventilation, lighting) and psychosocial factors (e.g. time pressures, workload, job insecurity, and perceived risk) have all been linked to levels of psychological well-being, including job satisfaction among offshore personnel, unfavourable conditions being associated with lower levels of well-being.

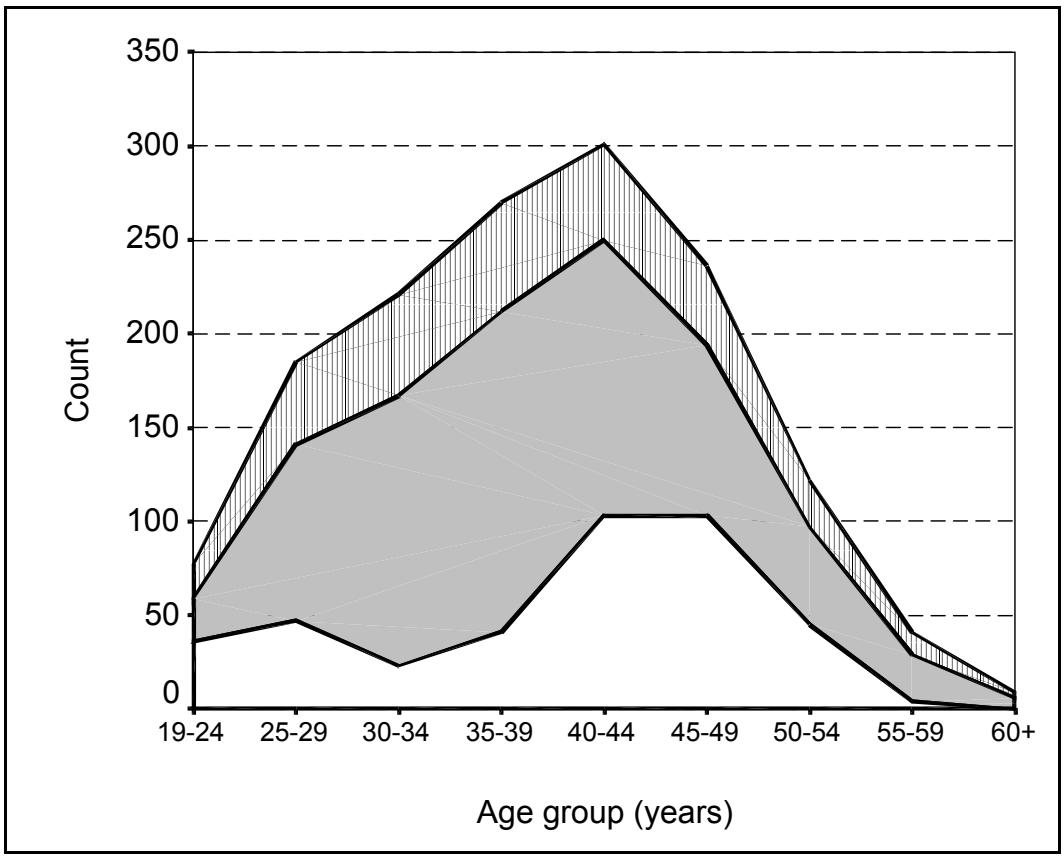


Figure 1.1
Age distribution of offshore personnel in relation to employing company

Production operator Drilling operator Contractors

This graph shows the age distribution of personnel (N=1462) who participated in the survey study reported in Part IV. It reflects the age profile in the offshore oil industry as a whole, and illustrates the marked predominance of personnel in the 40-50 years age range, particularly among those employed by production operator companies. Drilling operator personnel and those employed by contracting companies have a marginally younger age profile but the proportion of employees age 24 years or less is very small in the workforce as a whole.

Shift work. Shift rotation patterns and work/leave schedules are major factors in the organization of offshore work. In particular, the abrupt circadian changes inherent in day/night shift rotation offshore have adverse implications for sleep, performance and health. In addition, evidence suggests that there may be a long-term cumulative impact of shift work exposure on health impairment.

Much of the research cited in the review dates from earlier years of North Sea development when the problems facing the industry were different from those of present concern. The studies summarised in the following sections formed a programme of work designed to meet the need for up-to-date information about the physical and psychosocial environment offshore, and its impact on the health and safety of offshore personnel.

Part II. A five-year follow-up study (1990-1995) of offshore and onshore personnel

K. R.. Parkes and T. D. B. Razavi,

2.2.1 Summary

Production operators (N=172) working for a major oil and gas company, either onshore (n=88) or offshore (n=84), who participated in a study of day/night shift work carried out in 1990, were followed up in 1995. Of the original participants, 104 personnel (53 and 51, from the onshore and offshore groups respectively) were successfully traced. Five sub-groups were identified on the basis of employment situation in 1995 as compared with 1990; no job change (n=49); remained with same company; promoted (n=29); moved to a different company (n=13); unemployed (n=4); and retired (n=9). Only a small number of personnel had moved from onshore to offshore work (n=3) or vice versa (n=6).

The main focus of the study was on changes in job satisfaction and health in relation to changes in employment situation between 1990 and 1995. Overall, a pattern of unfavourable change was found, particularly among onshore personnel. Thus, perceived job demand and anxiety increased, and morale decreased, over the five-year period; these changes were found both onshore and offshore, but were more marked onshore. Increased anxiety was partly accounted for by increases in perceived demand. Those who remained in the same job tended to show more unfavourable change than those who moved to new jobs.

This pattern of results was consistent with the general re-structuring that took place in the decades from the mid-1980's, giving rise to concerns about job security and associated reduction in morale among the personnel concerned. The finding that onshore personnel experienced greater negative change than those offshore between 1990 and 1995 may have been due to the fact that structural changes occurred in the offshore environment several years earlier than corresponding changes onshore.

Other analyses examined the role of age, duration of shiftwork experience and duration of offshore experience in relation to health measures in light of the suggestion that shiftwork may have cumulative adverse effects on health. Sickness absence rates were also examined, and reported incidence of health complaints compared with normative data. Whilst the overall picture suggests some cause for concern, further longitudinal studies based on larger and more heterogeneous samples are required to enhance our understanding of the impact of changes in work conditions (particularly those associated with organizational restructuring and cost reduction measures) on the health of offshore personnel.

This small-scale study served as a pilot for more extensive longitudinal research in which participants in the 1995-6 survey were followed up in 2000.

2.2.2 Key findings

Mental health. Anxiety among both offshore and onshore personnel increased from 1990 to 1995. This increase occurred across all employment situations, except among those who had retired (Figure 2.1). There was also a significant deterioration in morale from 1990 to 1995; only personnel who moved to a new employer showed improved morale. Adverse changes in both anxiety and morale were particularly marked among those who became unemployed.

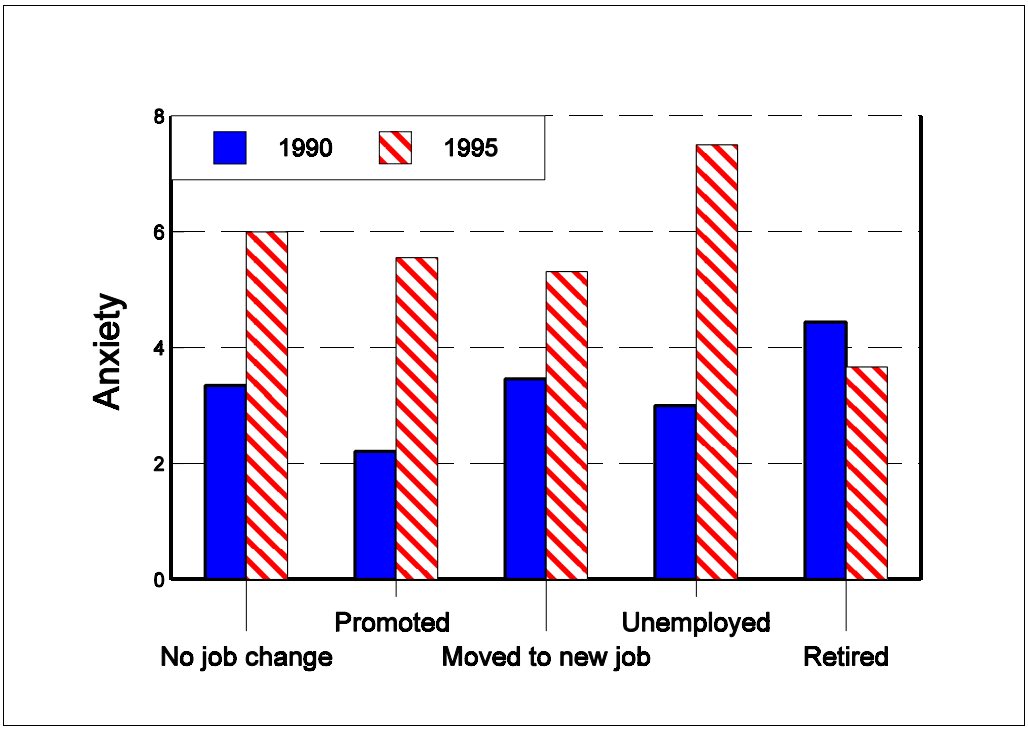


Figure 2.1
Anxiety in 1990 and1995 in relation to 1995 employment situation

Anxiety among both offshore and onshore personnel increased significantly from 1990 to 1995. This increase applied to all types of employment change, except the retired group.

Onshore/offshore differences. Increase in anxiety over the five-year follow-up period was greater among onshore than offshore personnel. The onshore group also showed a more marked increase in perceived job demand. Approximately 30% of the increase in anxiety in both groups was accounted for by the perceived increase in job demand. As compared with offshore personnel, the onshore group showed a greater decrease in morale.

Job change. In both the onshore and offshore groups, promotion or move to a new employer was associated with increases in job discretion and job satisfaction; favourable changes in these measures did not occur among those remaining in the same job. However, job change did not mitigate the increase in anxiety found in all groups remaining in employment in 1995 (Figure 2.1).

Minor health problems. Both onshore and offshore, minor health complaints, particularly sleep complaints, were frequently reported. Headaches were more frequent onshore than offshore (57% vs 34%), but other health problems (sleep, gastric and musculo-skeletal disorers) were more frequent in the offshore group. Among those remaining employed, there was a general tendency for increases in reported health problems between 1990 and 1995; however, those no longer working showed a decrease in health problems.

Shift work. Greater experience of shiftwork was associated with a significant deterioration in self-reported health. Thus, longer duration of shift work exposure was associated with poorer health ratings in 1995; this relationship was significant over and above the effects of 1990 health status, age, and years offshore.

Part III. Sleep, mood, and performance in relation to offshore shift rotation schedules

K. R. Parkes, M. J. Clark and E. Payne-Cook

2.3.1 Summary

Offshore shift work poses major difficulties of scheduling day and night shifts, and the pattern of rotation between them. The aim of this study was to compare 'fixed-shift' and 'rollover' schedules in terms of sleep, mood, and cognitive performance. Two rollover patterns, 7 night /7 days (7N+7D) and 7 days/ 7nights (7D+7N), and one fixed-shift pattern in which 14 day shifts and 14 night shifts were worked on alternate tours (14D/14N), were included in the study.

Data were collected on four North Sea platforms, one working the 7D+7N pattern, one working the 7N+7D pattern, and two working the 14D/14N pattern. For analysis purposes, the two-week work cycle was divided into three test phases, each covering three consecutive shifts. Prior to the first two phases, 'practice' shifts (during which data were collected but not analysed) were scheduled, and phases were separated by one or two 'rest' shifts (during which no data were collected). Assessments were carried out at the start, middle, and end of each test shift. Individual hand-held computers, programmed to present a sequence of self-report items (measures of sleep, subjective alertness, and workload) and cognitive performance tests (including reaction time) were used for data collection. A total of 95 personnel, mostly working in production areas, took part.

Rollover patterns were compared with fixed-shift schedules; the 14D *vs*.7D+7N and 14N *vs*. 7N+7D analyses were carried out separately, controlling for initial differences. The 14D group showed relatively stable responses throughout the two week work cycle, and adaptation to night work was evident in the 14N group during the second week offshore. However, rollover patterns gave rise to significant impairments as compared with the corresponding fixed-shift schedules.

For the 7N+7D group, the initial adjustment to night shifts was followed by a further 12-hour circadian change at the start of the second week; consequently, the operators concerned showed impaired alertness and performance from the start of the night shift week through to the end of the second week. The disruptive effects of rollover were also evident in the 7D+7N group relative to the 14D group; although normal day-shift response patterns were evident in the first week, almost all measures showed significant decrements following the mid-cycle shift change. Figures 3.1 - 3.3 show illustrative results for patterns of sleep hours, subjective alertness and reaction time across the three work phases for different shift sequences. Table 3.1 shows estimated sleep deficits over the two-week tour for rollover and fixed-shift schedules, again demonstrating more favourable findings for the 14D/14N pattern.

Overall, the findings for sleep, mood, and performance revealed that the 14D/14N rotation pattern, which greatly reduces the frequency of circadian changes, had many advantages over rollover patterns. Other factors are also relevant. Thus, survey data from 260 offshore personnel indicated a widespread preference for the 7N+7D rollover pattern, which allows personnel to adjust to a normal sleep/wake cycle before going on leave. Operational constraints, such as helicopter schedules and crew change arrangements, must also be taken into account.

Thus, this study highlights the conflicting factors that underlie decisions about shift rotation schedules. There are no simple answers to these problems. The advantages and disadvantages of the rotation patterns studied are summarised in the following tables to assist managers and offshore personnel in identifying shift patterns that optimise the safety, efficiency, and well-being of those concerned, and that are appropriate to the particular circumstances in which the company operates. Within this framework, it is suggested that a strong case can be made for implementing 'fixed-shift' rotation patterns that eliminate mid-cycle rollovers, and minimise the frequency of circadian changes to which personnel are exposed. This recommendation is strengthened by increasing evidence suggesting that long-term adverse health effects of day/night shift work (including cardiovascular disease) are linked to circadian disruption.

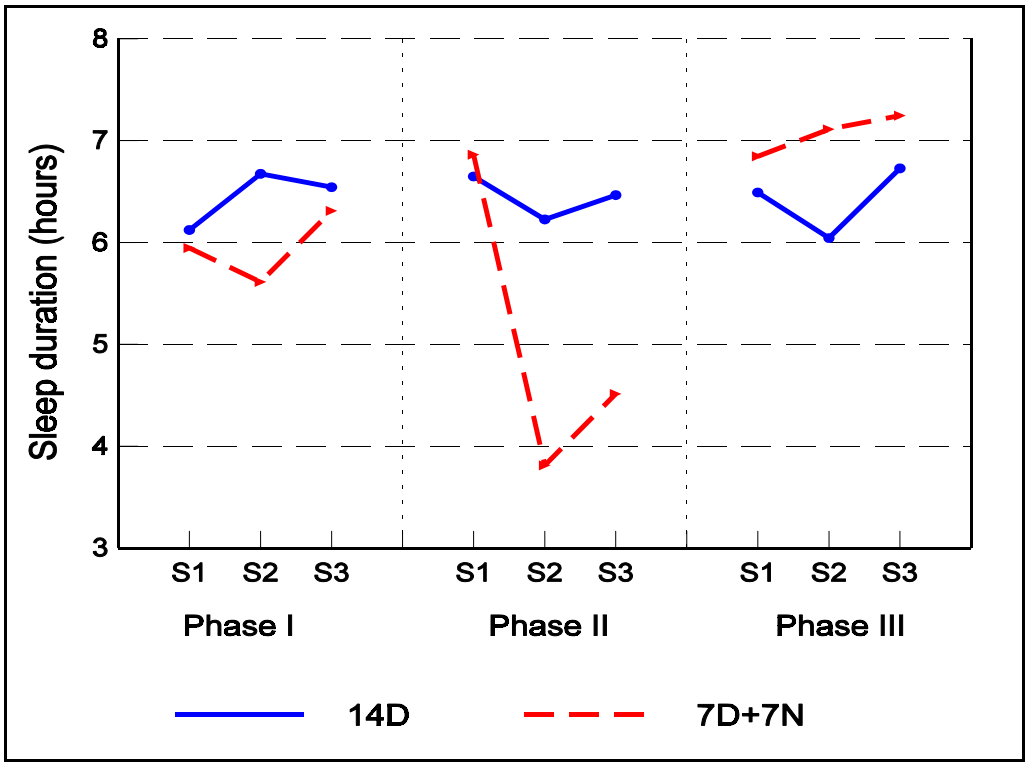


Figure 3.1
Sleep duration in relation to shift rotation: Days vs. Days/nights

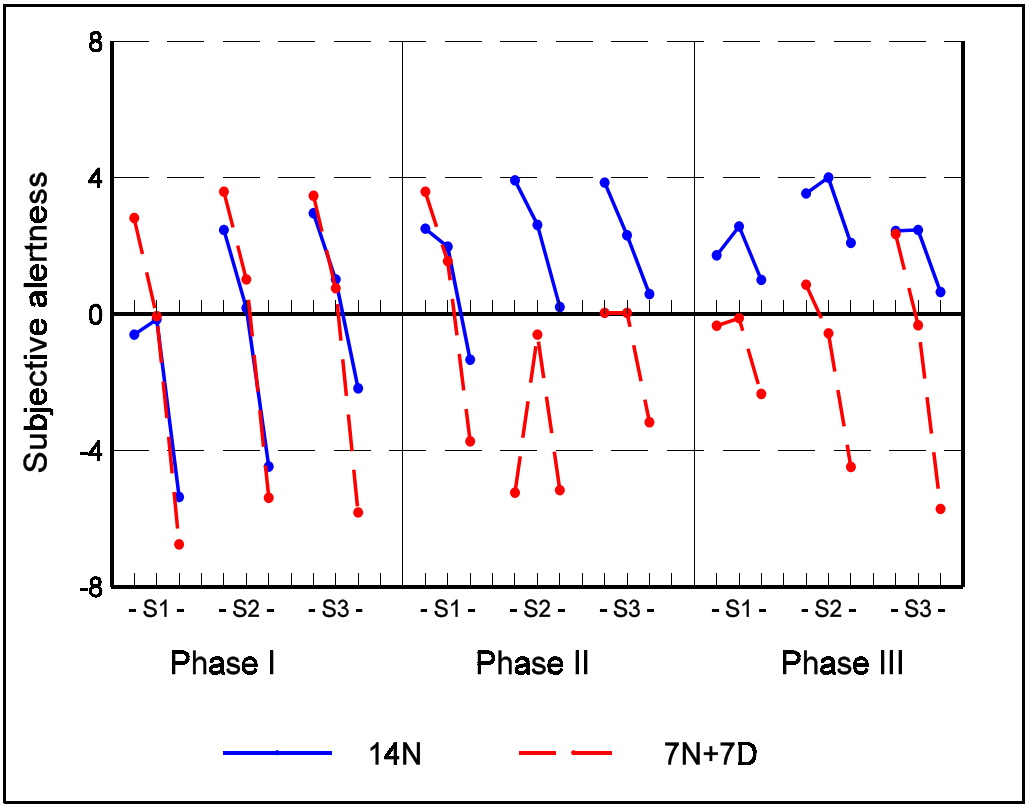


Figure 3.2
Alertness across phases: Nights vs. nights/days

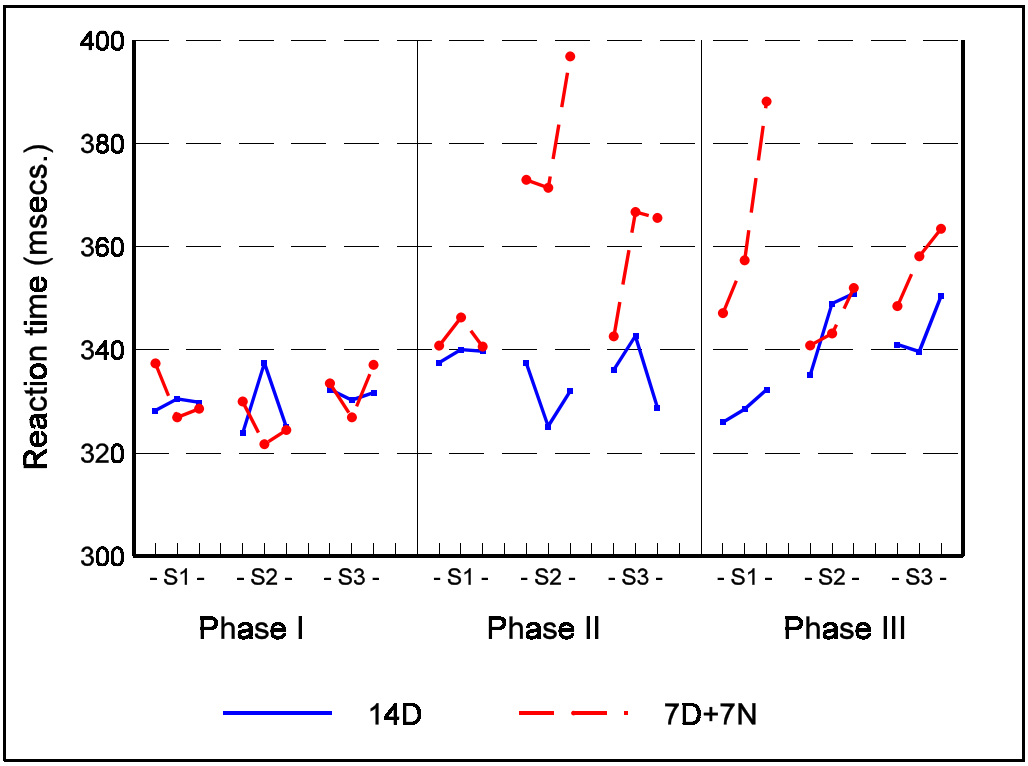


Figure 3.3
Reaction time across phases: Days vs. days/nights

Table 3.1
Estimated sleep deficits in relation to shift rotation patterns

Shift rotation pattern	Estimated sleep deficits			
	Day shifts (hrs. per day)	Night shifts (hrs. per day)	Rollover (total hours)	Estimated total sleep deficit over two-week tour *
7N+7D	1.31	1.33	4.5	**20.3**
7D+7N	1.05	1.21	4.3	**17.7**
14D	.90	---	---	**12.6**
14N	---	1.175	---	**16.4**
Average 14D/14N				**14.5**

C *The data shown in the final column represent the total sleep deficit (in hours) over the two-week offshore duty period relative to sleep during shore leave*

2.3.2 Key findings

Reflecting the fact that none of the three day/night rotation patterns currently in use on offshore production installations provides an ideal solution to the problem of shift scheduling, the main findings of this study are set out in the form of tables documenting the advantages and disadvantages of each of the patterns studied.

Rollover schedule: 7N+7D

ADVANTAGES

- Widely preferred by offshore personnel. 87% of those working the 7N+7D pattern, and 73% of the survey sample analysed, opted for this schedule.
- Because personnel adjust to and from night-shift work while offshore, they are not exposed to the need for circadian change during the first few days of shore leave. Avoids the need for day-time travel while night-time adjusted.
- Ease of scheduling as everyone works the same shift sequence on each tour.
- Only one shift team leaves each week; therefore, there is always one team to cover between departure of one crew, and arrival of the new crew.

DISADVANTAGES

- Gives rise to the largest sleep deficit over the two-week offshore work period.
- Day-shift levels of sleep, alertness, and performance are not experienced during either week of the offshore work cycle; the first week is affected by adjustment to night work, and the second week by having to re-adjust from nights to days. As adjustment to a 12-hour circadian change takes more than a week (Monk & Tepas, 1985), crews working this pattern tend to show impaired alertness and performance throughout the entire work cycle.
- Marked deterioration in alertness and performance from start to end of shifts in both the night-shift and the day-shift weeks.
- Rollover schedules involve twice as many 12-hour circadian changes annually as fixed-shift schedules, with possible long-term consequences for health and sleep patterns.
- Offshore shift change schedules are necessarily of the 'backward' rotation type, involving short rest periods (usually 5 - 8 hours) during the rollover, which do not allow breaks of the duration (11 hours) currently specified in EU onshore recommendations.
- Each team rotates shifts with two other teams, one in the first week and one in the second week, with possible disruption to communication and co-ordination between day and night crews.

Rollover schedule: 7D+7N

ADVANTAGES

- First week of day shifts requires no circadian adaptation. Therefore, personnel have time to re-adapt to the offshore work environment before they have to adjust to night work.
- Performance, alertness and sleep during the first offshore week is not impaired by a prior week of night work.
- Ease of scheduling as everyone works the same shift sequence on each tour.
- Only one shift team leaves each week; therefore, there is always one crew to cover between departure of one crew, and arrival of the new crew.

DISADVANTAGES

- Strongly disliked. Only 16% of those working the 7D+7N pattern indicated that it was their preferred pattern, and no one working other rotation systems opted for it.
- It takes longer to recover from night shifts than from day shifts at the start of shore leave. The 7D+7N pattern requires personnel to re-adjust to a normal sleep/wake cycle during the first few days of leave after every offshore tour.
- Impaired alertness and performance during shifts immediately following the rollover. Marked performance decrements at the end of these shifts.
- Tends to produce an uneven distribution of work across the two-week offshore tour to allow lower workload during the rollover phase.
- Rollover schedules involve twice as many 12-hour circadian changes annually as fixed-shift schedules, with possible long-term consequences for health and sleep patterns.
- Offshore shift change schedules are necessarily of the 'backward' rotation type, involving short rest periods (usually 5 - 8 hours) during the rollover which do not allow breaks of the duration (11 hours) currently specified in EU onshore recommendations.
- Each team rotates shifts with two other teams, one in the first week and one in the second week, thereby potentially disrupting co-ordination and communication between shift teams.

14D/14N Fixed-shift schedule

ADVANTAGES

- Lowest overall sleep deficit for both day and night shifts
- Greater stability of subjective alertness and performance over the two-week cycle. In particular, adjustment to night-shift work is not disrupted by the need for further circadian adaptation resulting from a mid-cycle shift change.
- Little or no significant deterioration in alertness or reaction time over the course of individual shifts, either during days or, after initial adaptation, during nights.
- Of the shift patterns studied, the 14D/14N pattern requires the smallest number of 12-hour circadian changes in the course of a year (5-6 in the days-to-nights direction, depending on the work/leave pattern operated, and a similar number to return to a normal cycle). Alternate offshore tours involve only day shifts, with no major circadian adjustment required.
- The 14D/14N pattern allows the same night and day shift teams to work together through the entire two-week period, thus enhancing handover and co-ordination between the night and day crews.
- The 14D/14N pattern was advocated by Lauridsen *et al.* (1991) on the basis of an extensive survey of sleep and health among offshore shift workers.
- Among employees (mainly contractor personnel) working a regular 2-2 work/leave schedule, scores on the 'satisfaction with shift rotation' survey item were comparable to those for the 7N+7D pattern, and significantly higher than those for the 7D+7N pattern.

DISADVANTAGES

- Operators dislike going on leave after two weeks of night shifts, because their first few days of leave are disrupted by the need to re-adjust to a normal sleep/wake cycle. A further problem is the potential danger of driving home the day after completing two weeks of night shifts.
- Fewer than half the operators (42%) working the 14D/14N schedule preferred it; the remainder opted for the 7N+7D schedule.
- Complicates the planning of work rotas as it is necessary to schedule alternating night-work and day-work tours, rather than assume that the same rollover sequence will apply to everyone concerned on each trip.
- To ensure that essential jobs are covered at all times, the 14D/14N schedule requires two helicopter flights on same day for crew-change purposes so that the incoming day-shift team arrives before the departing team leave. Alternatively, successive

Part IV. The offshore environment in the mid-1990s: A survey of psychosocial factors

K. R. Parkes and M. J. Clark

2.4.1 Summary

This report presents findings from the analysis of survey data obtained from 1462 male offshore personnel employed on 11 production platforms and 6 drilling rigs operating in the UK sector of the North Sea. All the main occupational groups working offshore took part; the overall response rate was 83%. A wide range of psychosocial information was collected; the subjective data analysed included measures of exposure to physical environment stressors, perceived job characteristics, total working hours per offshore week, perceptions of safety measures and procedures, measures of psychological well-being, and minor health problems.

These measures were examined in relation to company groups, installations within groups, job types, and employer groups (i.e. operator personnel *vs* contractors); individual differences in age and in 'negative affectivity' were taken into account in these analyses. In addition, installation characteristics, such as size and age, were also examined as predictors of psychosocial variables.

The results demonstrated that companies, installations and job types were all significant predictor variables, although the precise pattern of results varied for different outcome measures. Personnel in the eight different job types differed on almost every measure; in particular, profiles of perceived job characteristics highlighted differences between jobs which were reflected in measures of job satisfaction, psychological well-being, and physical health.

Satisfaction with safety measures and procedures was generally high, as were the ratings of safety associated with specific work activities. Personnel directly involved in any particular activity rated it as more safe than those not involved; also, management personnel gave higher overall ratings than those in other job types. With few exceptions, almost everyone in the sample considered the installation on which they worked to be average or above-average in safety.

Analysis of the data relating to minor health problems revealed specific patterns whereby day/night shift rotation was associated with sleep disturbance and gastric problems, while job types differed in the incidence of musculo-skeletal problems and headaches. Heavy smokers also reported a relatively high incidence of health problems, independently of other factors. The overall levels of 'stress' symptoms in the present sample were significantly lower than those of comparable employees in manufacturing industry onshore, but anxiety levels were significantly higher than those observed in an offshore sample in 1990.

These and other aspects of the present study are discussed in relation to previous research into psychosocial aspects of the offshore environment, and in the light of more recent developments in North Sea work conditions. Methodological strengths and limitations of the present study are also considered.

2.4.2 Key findings

Physical environment. Job types predicted perceived exposure to physical stressors; drilling and construction personnel reported the highest levels of exposure, while the lowest levels were reported by catering and office-based personnel. Company groups also differed in overall exposure levels, and personnel on older production platforms reported higher levels than those on more recently constructed installations.

Job characteristics. Job type was a significant predictors of each of the job characteristics measures (workload, autonomy, skill/variety, and clarity), but the pattern of scores was different for each measure (see Figure 4.1). Additional roles (e.g. fire team responsibilities) were also associated with higher perceived workload, and workload on production platforms was perceived to be higher than that on drilling rigs.

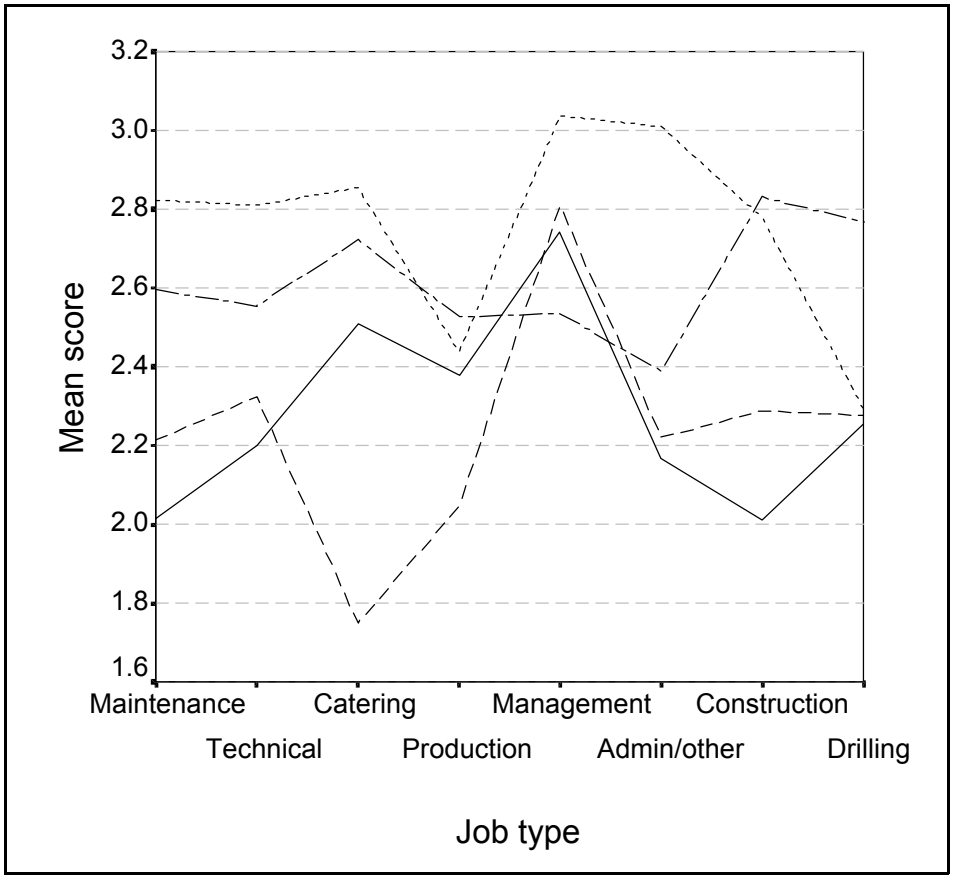


Figure 4.1
Job characteristics profiles across job types

Workload
Autonomy
Skill/variety
Clarity

This diagram shows the profiles for four job characteristics across the different job types identified. Scores on each characteristic ran from 0 to 4, higher scores representing a higher level of the attribute concerned. Management personnel reported the highest levels of workload, but catering staff and production operators also showed high levels. The highest levels of skill/variety were found in management roles, while catering and, to a lesser extent, production jobs, showed relatively low levels. Autonomy was high for both management and administration jobs, and lowest for those in production and drilling. Job clarity showed less variation across jobs, although tended to be higher in predominantly manual occupations. The overall picture was of more favourable job profiles among management personnel, for whom the adverse effects of high workload were offset by the greater skill, variety, and control afforded by the work.

Satisfaction with job prospects. Satisfaction with job security, promotion opportunities, and future career prospects (mean score on a 1 to 5 scale) was dependent on job type, but the pattern of results differed across employing companies. Age was also significant; both younger and older personnel were more satisfied with job prospects than those in the middle age ranges, particularly 39 - 44 years (see Figure 4.2). Participants on larger and/or newer platforms perceived their future job prospects more favourably than other personnel.

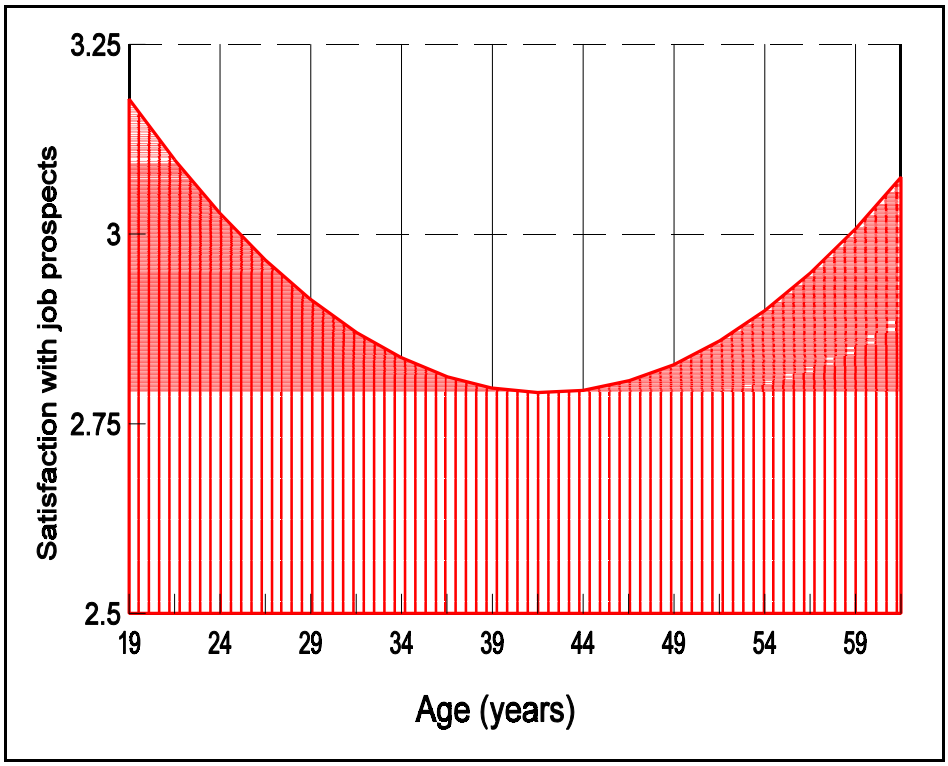


Figure 4.2
Satisfaction with job prospects in relation to age

Job satisfaction. Management personnel reported higher job satisfaction than other job types, and production and catering personnel reported lower levels. Age was also a significant predictor of job satisfaction, higher age being associated with greater job satisfaction.

Psychological well-being. 15% of participants showed high levels of 'stress' symptoms; this level was comparable to that reported for other offshore samples. Anxiety varied with job type; catering, production, management and drilling personnel tended to have higher scores than other groups. Differences in job characteristics partially explained these different levels of anxiety.

Physical health. Specific health problems were associated with particular work characteristics. Thus, shiftwork predicted gastric problems and sleep disturbance, higher rates being observed among day/night shift workers than among day-shift workers. Job type predicted musculo-skeletal problems and headaches, drilling personnel reporting high incidences of both these health complaints.

Health behaviours. Smoking was more frequent among the personnel in this sample than among comparable groups onshore; 14% of the present sample were moderate smokers, and 22% smoked heavily. Drilling rig and catering personnel had high rates of smoking relative to other groups; heavy smoking was linked to several adverse health outcomes, including gastric problems. Body mass index (a measure of weight relative to height) was above average in this sample (mean 25.6 kg/m^2), but was lower among drilling and catering personnel as compared with management personnel; as in the general population, age was positively predictive of body mass index.

Safety. Almost all personnel considered their installations to be average or above-average in safety compared with other North Sea installations. However, newer and/or larger platforms tended to be rated more favourably than older and/or smaller platforms, and more personnel on platforms gave negative ratings (see Figure 4.3). There were also some differences between individuals in safety perceptions: managers perceived the safety of work activities more favourably than other job groups, and accommodation and office-based personnel were more satisfied with safety measures and procedures. Personnel who were directly involved in a particular work activity gave higher safety ratings for that activity.

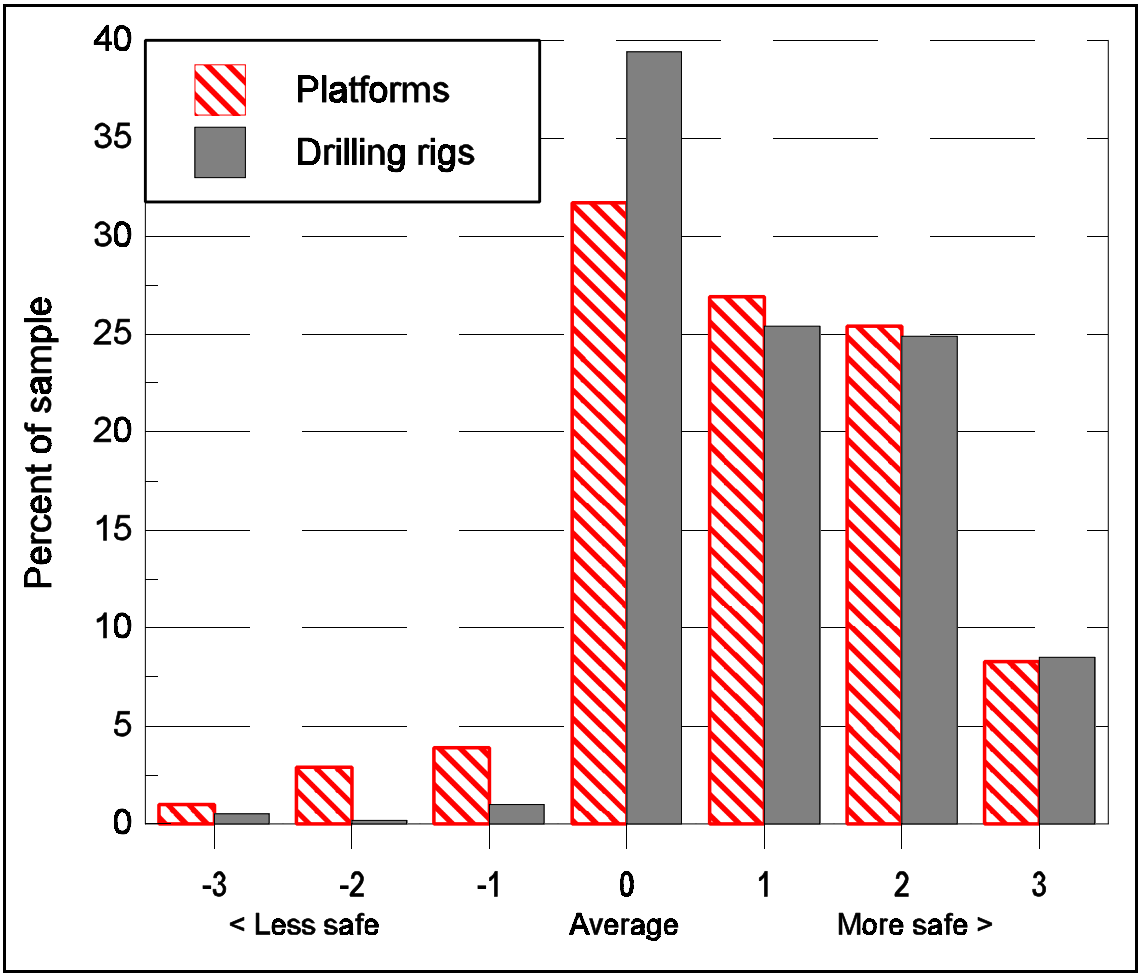


Figure 4.3
Overall safety perceptions in relation to installation type

Production platforms and drilling rigs were broadly similar in terms of overall safety perceptions, which were generally positive. In general, ratings of 'below average' were rare, particularly among drilling rig personnel. One particular installation accounted for most of the unfavourable ratings among production platform personnel.

Part V. Offshore work/leave schedules: Data analyses and review

K. R. Parkes and M. J. Clark

2.5.1 Summary

In recent years, offshore work/leave patterns have become a topic of increasing importance in the North Sea oil and gas industry as companies have focused on the dual aims of enhancing safety and reducing costs. In this context, it has been suggested that both purposes could be served if a 3-3 work/leave pattern (i.e. three weeks offshore alternating with three weeks shore leave) were operated on offshore installations in place of the more usual 2-2 pattern (i.e. two weeks offshore alternating with two weeks shore leave).

Although many of the personnel concerned were dismayed at the possibility of three consecutive weeks offshore, there is little direct evidence about the effects of longer work/leave cycles on the performance, health and psychological well-being of offshore personnel and their families. Reflecting the large gaps in current knowledge, the present report does not seek to make recommendations about optimum work/leave patterns; rather, it is intended to set out what is currently known, and to suggest areas on which future research could usefully focus.

Little of the information currently available about the psychosocial environment offshore, and the mental and physical health of offshore employees, relates to personnel working three-week tours. The work described in this report draws on a variety of sources and data to examine the psychosocial implications of three-week offshore tours as compared with the more usual two-week tour duration.

The information presented includes a summary of relevant literature, a comparison of different work/leave patterns in terms of the attitudes and preferences of offshore personnel, a pilot study of mood and sleep patterns among personnel working either a two-week or a three-week tour at the time of data collection, and material from interviews with wives of offshore personnel, focussing on family issues associated with offshore employment, including work/leave cycles.

Some general points about the implementation of 3-3 work patterns, and suggestions for a more extensive study of the psychosocial and health implications of such schedules are noted in the conclusions.

2.5.2 Key findings

Literature review. Almost all existing literature on health and psychosocial factors among North Sea personnel relates to a 2-2 work schedule. Other than a Soviet study which compared one-week and two-week offshore cycles (Alekperov *et al*. 1988), the issue of work/leave schedules does not appear to have been addressed. However, in the context of the 84 hours (and often longer) worked per week by offshore personnel, it is relevant that long work weeks onshore (60 hours work in seven days) have been found to give rise to substantially impaired performance and mood relative to the normal 40-hour week (Proctor *et al.,*1996). Moreover, extending offshore tours from two weeks to three weeks might intensify the domestic and family problems of 'intermittent husband absence' (Taylor *et al*. 1985).

Satisfaction with work/leave patterns. Among personnel working 'equal time' schedules (N=1130), those working three-week offshore tours were significantly less satisfied with their work/leave pattern than those working two-week tours. A conspicuous feature of the results was the low level of satisfaction with 3-3 schedules reported by personnel on production platforms (see Figure 5.1). However, a small proportion of personnel (mostly on drilling rigs) reported that they preferred the longer work/leave cycle.

Attitudes to 3-3 working. An anticipated change from the existing 2-2 schedules to schedules involving three consecutive weeks offshore was perceived very negatively by the personnel concerned (n=113). The longer work/leave cycle was viewed particularly unfavourably by those with children living at home as compared with those without children, but attitudes also depended on the existing schedule at the time the proposed change to 3-3 working was announced.

Effects of 3-3 schedules on mood and sleep. A pilot study in which day-shift personnel (n=55) completed daily diaries recording sleep and mood provided no clear evidence of adverse effects on these measures of a third week offshore, although there was a trend towards reduced alertness across the three successive weeks (see Figure 5.2).

Responses of spouses to 3-3 working. The spouses interviewed (n=18) expressed considerable unease about three-week work patterns, although this topic was only one of a number of issues of concern to them. Disruption of family life, delays in making decisions while the offshore worker was away, and unease about having to cope alone for three weeks, were typical concerns. The possibility of taking full two-week holidays within a three-week leave period was seen as the only favourable feature of the longer work/leave schedules.

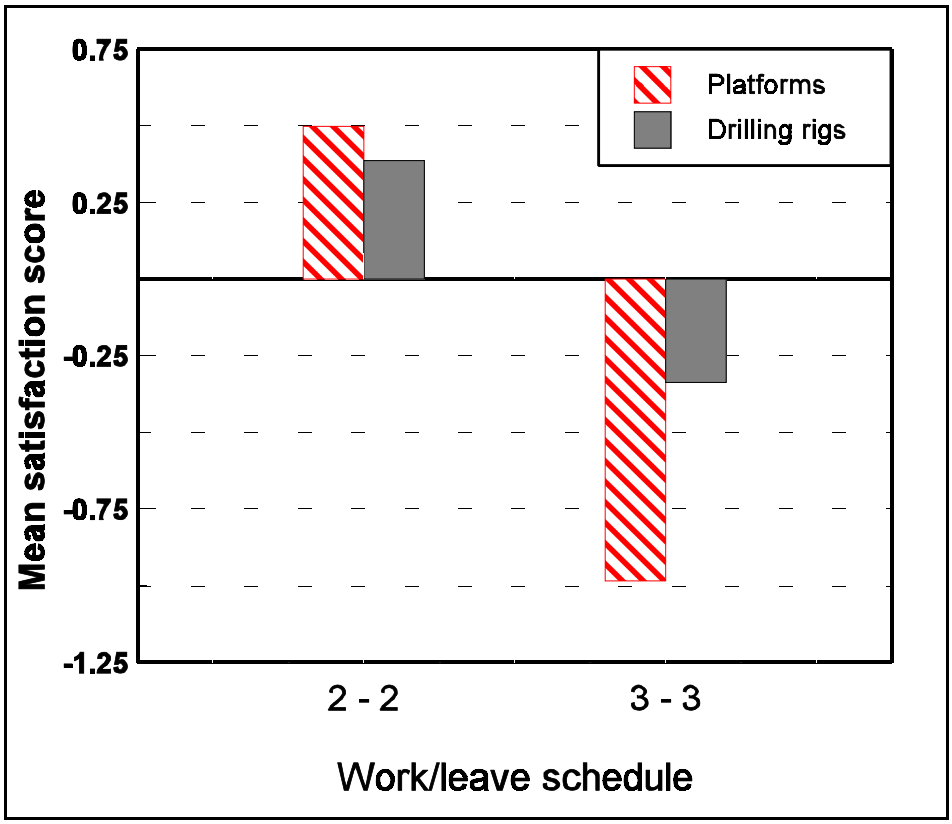
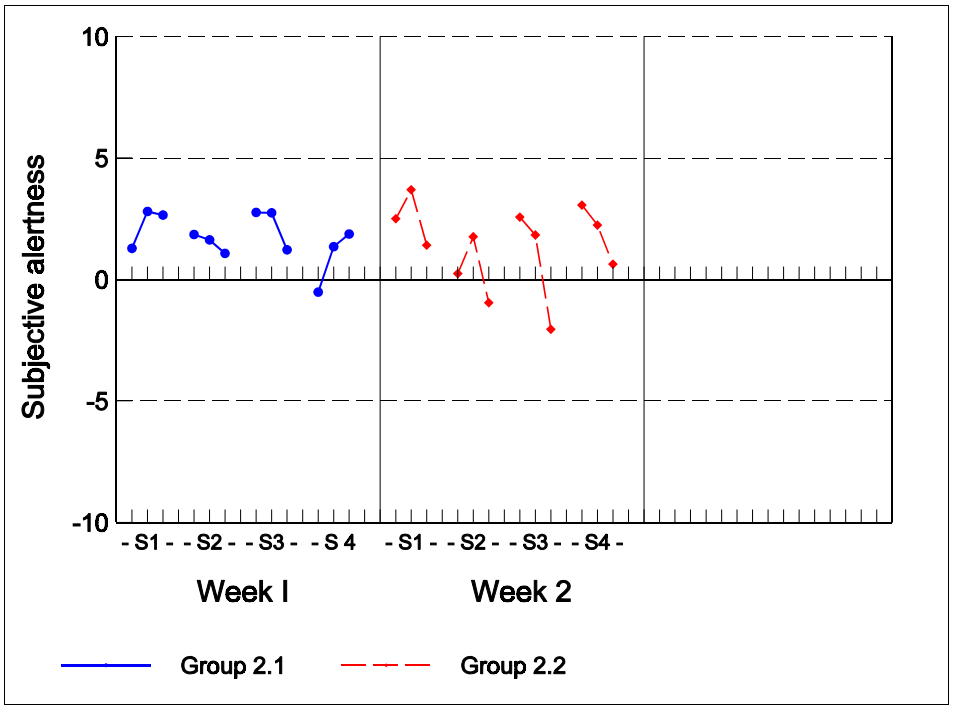


Figure 5.1
Satisfaction with 2-2 and 3-3 work/leave schedules on drilling rigs and production platforms



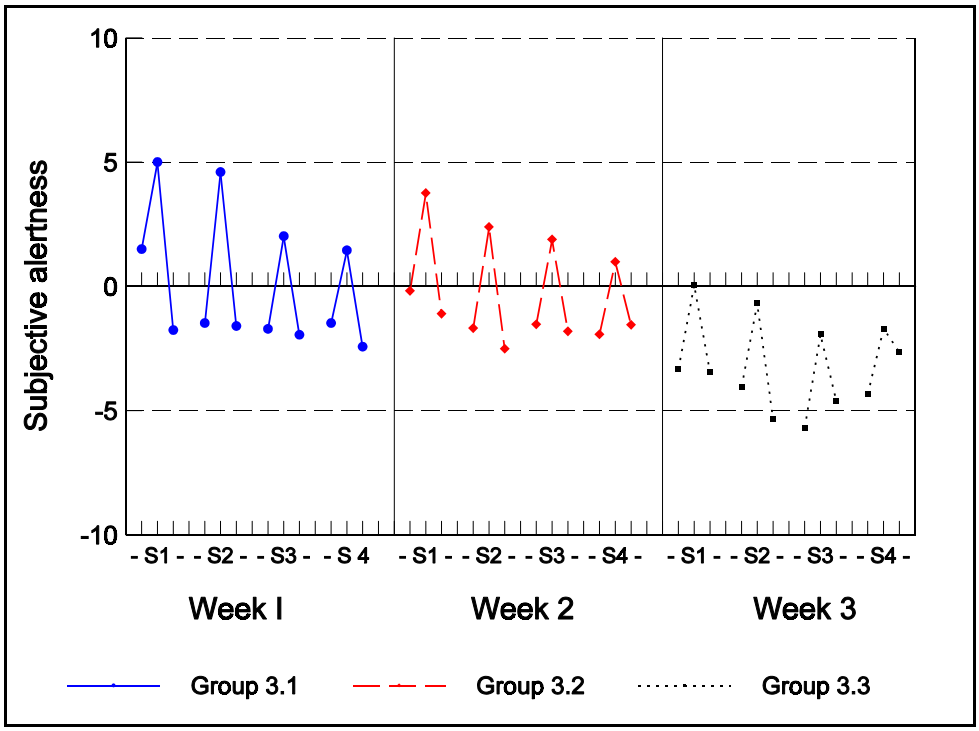


Figure 5.2
Alertness: The top diagram shows alertness during the first and second weeks for the 2-2 work leave schedule; the lower diagram shows the corresponding data for three successive weeks of the 3-3 schedule.

The three points plotted for each shift represent the start, middle, and end of shift respectively. Each of the five groups taking part contributed data for a single week.

Injuries on offshore oil and gas installations: An analysis of temporal and occupational factors

K. R. Parkes and S. Swash

2.6.1 Summary

This report examined injuries occurring on offshore oil and gas installations in relation to temporal and occupational factors. Three databases were analysed, one from the HSE Offshore Safety Division, and two from large multi-national oil and gas companies. The data provided information about the nature and severity of injuries incurred by offshore personnel in the UK sector of the North Sea, together with details of temporal aspects of the accident (e.g. clock time, hours-into-shift, days-into-tour), the work area involved, and the body part injured. The HSE data included three levels of injury (fatality, serious injury, 3+ days lost time), whereas the company data also detailed other minor injuries.

The data were analysed to identify temporal and occupational trends in injury occurrence. In carrying out the analyses, it was necessary to take into account that the numbers of personnel exposed varied across times and in different jobs. As no exposure rate data were available, to examine factors such as time-into-tour, day vs. night shifts, and work area, fatalities and serious injuries were analysed in relation to less serious injuries, the latter being taken as an indicator of exposure rates. Key findings from the HSE data (N=2602 incidents) are noted below. In the full report, implications of the findings for offshore work schedules are discussed.

2.6.2 Key findings

Days-into-tour. For tour durations longer than two weeks, the ratios of fatalities and severe injuries to 3+ day injuries increased markedly, relative to durations of 1-2 weeks. This pattern was evident in each of the three work areas examined, although it was more marked in production/maintenance and construction/deck work than in drilling (Figure 6.1).

Clock hours. The distributions of severe injuries and 3+ day injuries differed significantly across the 24-hour cycle. Both serious and 3+ day injuries were more frequent in daytime hours, reflecting the higher number of personnel working day shifts as compared with night shifts. However, the distributions of injuries in the two categories differed significantly over clock hours (Figure 6.2).

Day vs. night shifts. The distribution of injury severity differed significantly across day and night shifts, night shifts showing higher rates of fatalities/serious injuries relative to less serious injuries of 3+days (Figure 6.3). This effect was independent of days-into-tour.

Hours-into-shift. The total number of injuries reported differed across successive one-hour time periods during 12-hour shifts. For both day and night shifts, injuries tended to be more frequent during the first half of the shift than the second half (Figure 6.4), but there was a reduction in frequency over the mid-shift break. For work extending beyond the normal shift duration of 12 hours, the proportion of fatal/severe injuries relative to less serious ones (19%) was significantly higher than during the 12-hour shift duration (13%).

Injury severity in relation to incident type. The three levels of injury severity were found to be significantly differently distributed across incident type (classified into four categories, slips/trips/falls; handling goods; lifting/crane; and use of machinery). The proportion of incidents involving 'use of machinery' that resulted in a fatality or a serious injury was disproportionately high relative to other incident types (Figure 6.5).

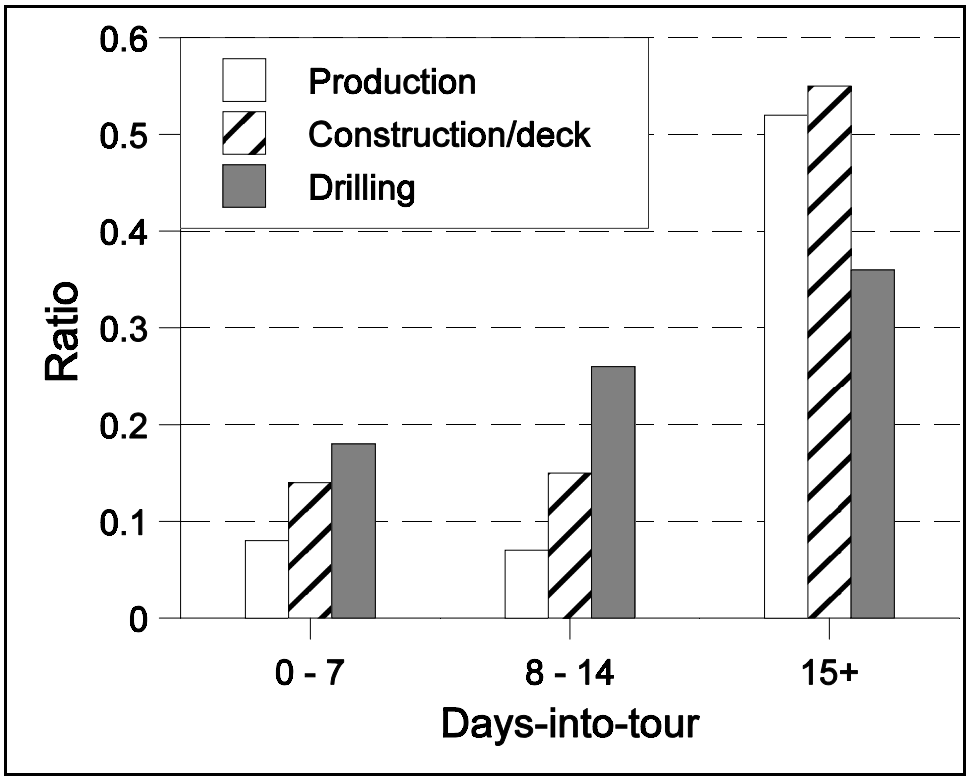


Figure 6.1
Ratio of fatalities/serious injuries to 3+ day injuries as a function of days into tour, for three areas of work

The increase in the ratio of fatalities/serious injuries to 3+ day injuries for tour lengths of 15+ days is particularly marked for the production /maintenance and construction /deck work areas. As compared with the other two job categories, the drilling area shows higher ratios during the first two weeks, and a less marked increase for tours of 15+ days. In interpreting these data, it should be noted that the actual numbers of incidents occurring 15+ days into tour is small relative to the numbers in the 0-7 days and 8-14 days categories, reflecting the fact that relatively few personnel work tours of duration more than two weeks.

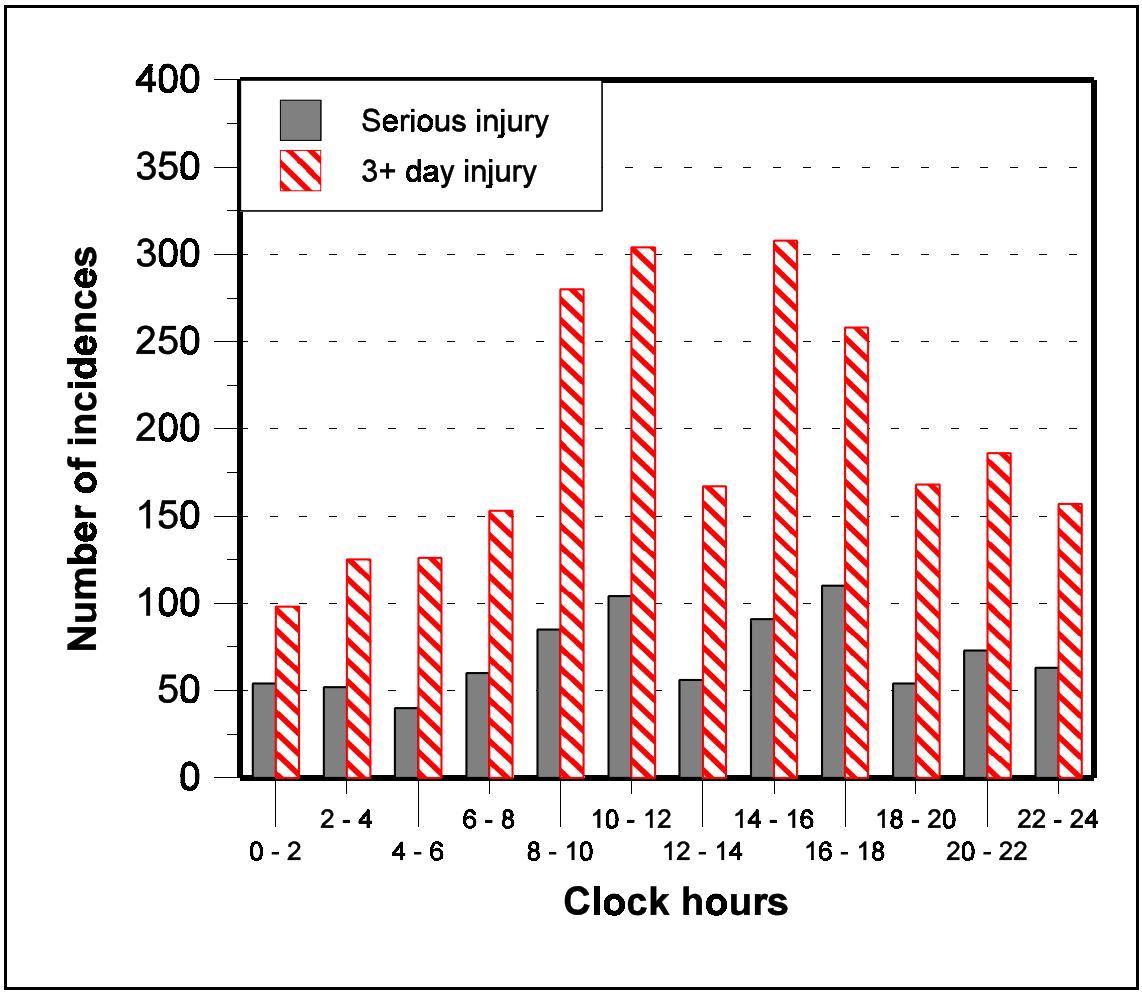


Figure 6.2
Distribution of injury severity over clock hours

With the exception of the mid-day break (12.00 - 14.00 hours), both serious and 3+ day injuries were more frequent during daytime hours, reflecting the higher number of personnel working day shifts as compared with night shifts. Overall, serious injuries made up approximately 26.5% of the total, but there was significant variation across successive two-hour time periods. In particular, serious injuries were disproportionately more frequent (55.1% of the total) in the time period 00.00 - 02.00 hours (the midnight handover period for personnel working shift patterns with a midnight/midday shift change).

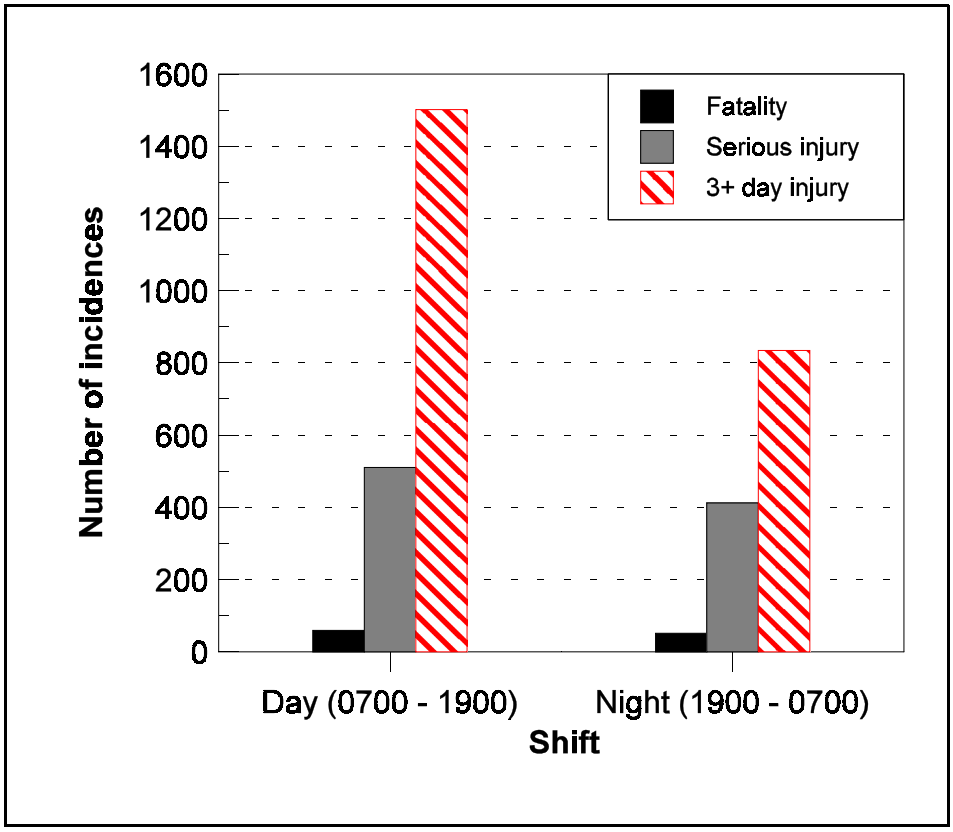


Figure 6.3
Distribution of injury severity across shift

The proportion of fatalities and serious injuries relative to 3+ day injuries is significantly higher during night shifts than during day shifts.

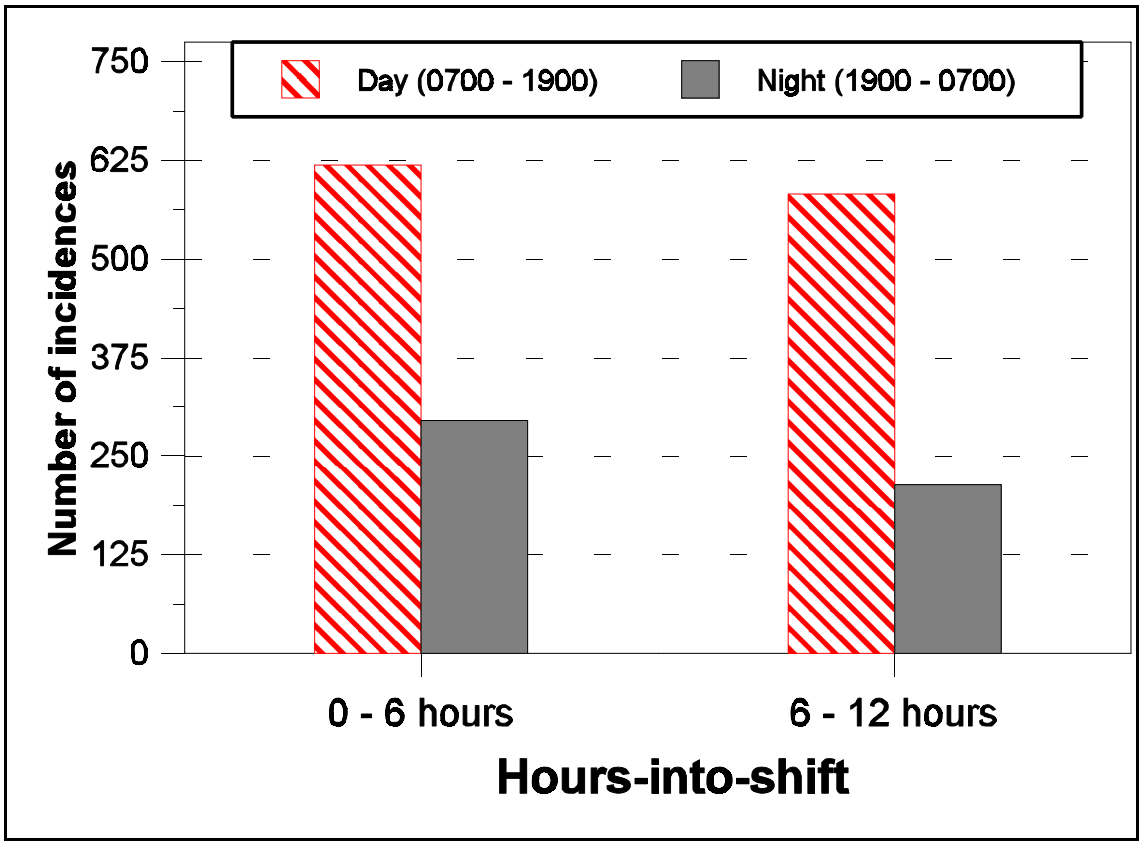


Figure 6.4
Number of incidences during first half and second half of 12-hour shifts for day and night shifts

Day and night shifts differed significantly in the relative numbers of incidences that occurred in the first half and the second half of the 12-hour shift duration. Consistent with the greater number of personnel on duty during the day, overall, there were more incidences during day shifts than during night shifts; there were also fewer incidences in the second half of the shift than in the first half. However, for night shifts, the second 6 hours had fewer incidence relative to the first 6 hours than would be expected from the corresponding levels during day shifts.

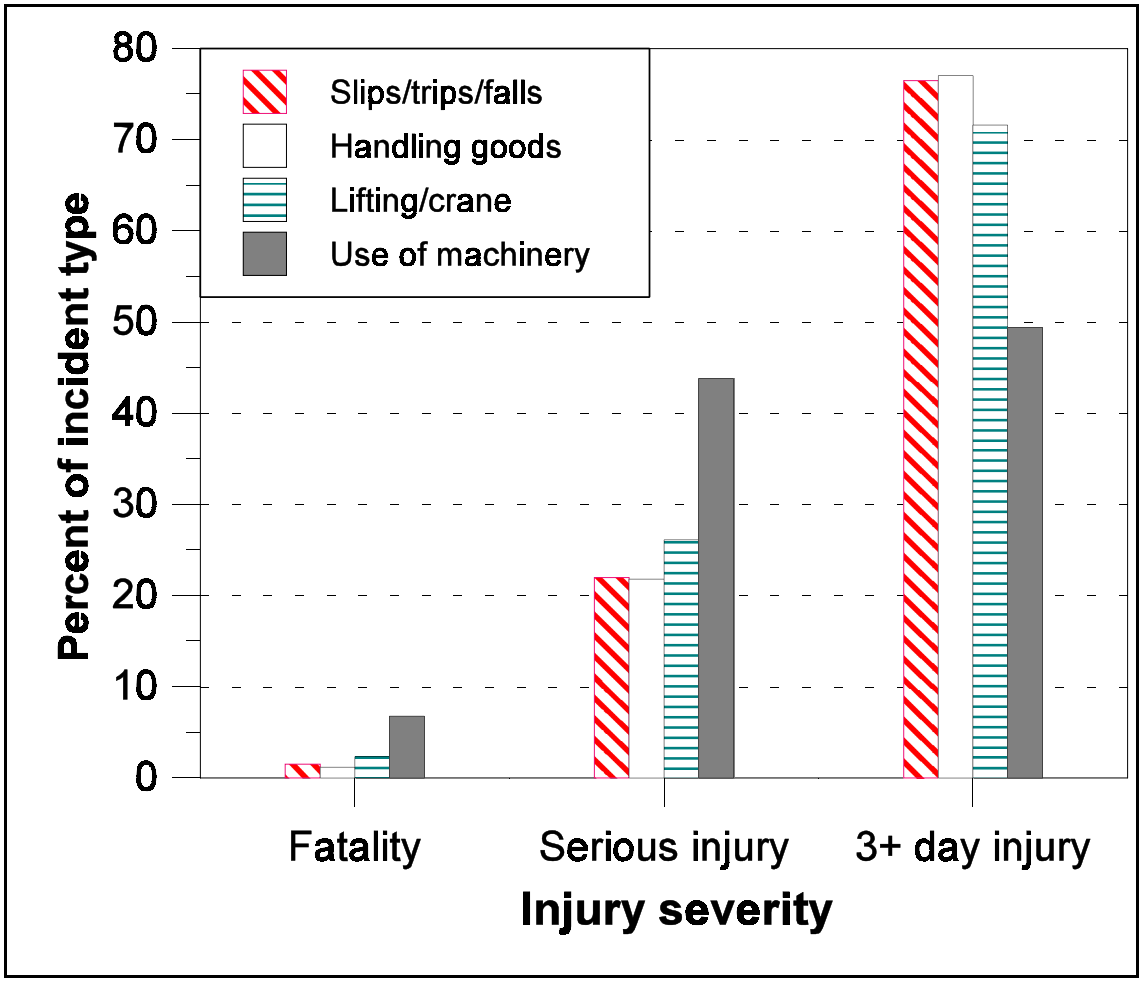


Figure 6.5
Injury severity in relation to incident type

The four most frequent incident types were examined in relation to the severity of injury. The three injury categories were found to be significantly differently distributed across the incident types. 'Use of machinery' was more likely to result in fatalities or serious injuries than incidences of the other three types.

Offshore sickbay consultations in relation to age, job factors, and self-reported health

K. R. Parkes and S. Swash

2.7.1 Summary

The main aim of this work was to examine the frequency and nature of offshore sickbay consultations in relation to personal and job-related factors, including age, job type, and shift work. Data relating to sickbay consultations were provided by a major North Sea operatiing company. In these analyses, the unit of analysis was the sickbay consultation (n=1944).

A further aim was to examine the correspondence between information about health problems derived from self-report survey data (collected in 1995-6) and that provided by sickbay consultation records for those years. In this case, the unit of analysis was the individual offshore worker (n=342).

Four main diagnostic categories were identified in the sickbay consultation data: musculo-skeletal, gastric, respiratory, and skin/wound. A further category, 'other' was used to cover all other diagnoses. Particular age groups, job types, job levels and shiftwork patterns were associated with disproportionately high consultation rates relative to their proportions in the sample. These factors were also related to significantly different frequencies of consultation for accidents as compared with illness, and with different diagnoses. The broad pattern of results was consistent with other findings relating to sickbay consultations, particularly the effects of job type, age, and shift work.

Examination of self-reported health data in relation to consultation records showed a significant correlation between total consultations and total health scores, but the correspondence within specific diagnostic categories was not very strong. Musculo-skeletal problems were one exception; for this type of disorder, the correlation between mean number of consultations and mean health scores was highly significant. However, musculo-skeletal consultations were also positively associated with symptoms of psychological distress, thus complicating the interpretation of this finding.

For the sickbay consultations made by personnel who took part in the 1995-6 survey, it was also possible to examine whether some particular sub-groups were disproportionately likely to attend the sickbay relative to their numbers on board; the results indicated that individuals in the 45.0 - 45.9 years age group; maintenance personnel (for illness) and construction personnel (for accident); personnel at the lowest job level; and shift workers all tended to show higher than expected consultation rates.

2.7.2 Key findings

Diagnoses. Respiratory and musculo-skeletal disorders were the most frequently recorded of the four specific diagnoses, accounting for 28.5% and 23.0% of the total respectively. In terms of 'reasons for consultation', illness accounted for 78.0% of the total consultations, accidents for 15.3%, and 'other' reasons (e.g. routine health monitoring) for 6.7%. The pattern of diagnostic categories varied significantly across the three 'reasons for consultation' categories, illness, accident and 'other'. Gastric and respiratory problems were almost entirely due to illness, whereas accidents played a significant role in musculo-skeletal and skin/wound consultations (Figure 7.1).

Job type and shift work. Job type was one of the most strongly predictive factors. Construction personnel had particularly high consultation rates for accidents, while maintenance personnel were the most likely to seek consultation for illness. Personnel in different job types also differed significantly in diagnosis. Gastric problems were disproportionately likely among production personnel, while musculo-skeletal problems were particularly associated with administrative jobs (see Figure 7.2). Shift work was also relevant. Day/night shift workers were more likely to attend the sickbay than day workers; they were also more likely to experience gastric problems.

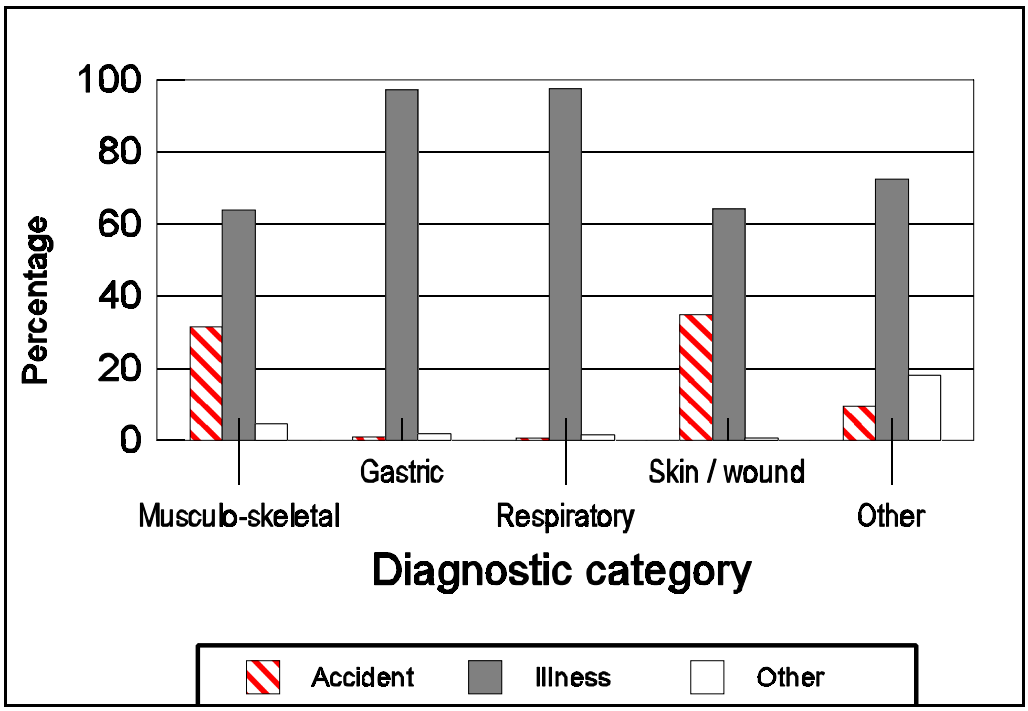


Figure 7.1
Percentage of consultations for accident, illness, or 'other' problem in relation to diagnostic category

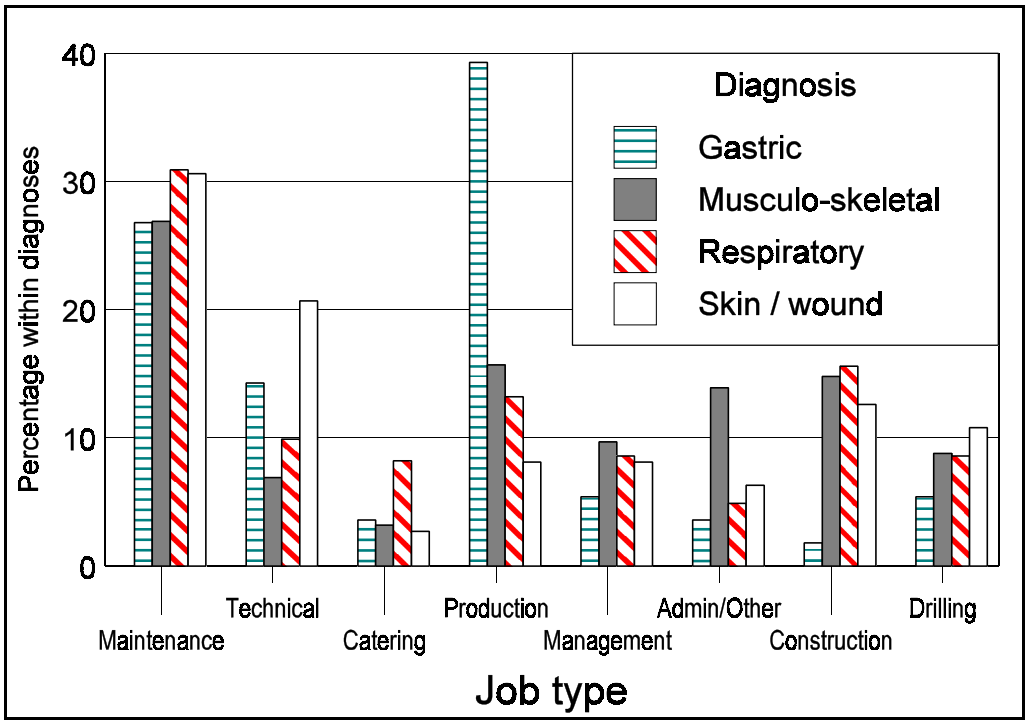


Figure 7.2
Percent of consultations in each diagnostic category in relation to job type

Age. Personnel in different age groups differed significantly in the relative proportions of accident and illness consultations; younger groups tended to have disproportionately more accident consultations while those in the 40-50 years age groups were more likely to consult for illness (see Figure7.3). This pattern did not continue beyond age 50 years, suggesting that personnel with impaired health may be more likely to give up offshore work at this age, leaving a particularly healthy sub-group of older personnel.

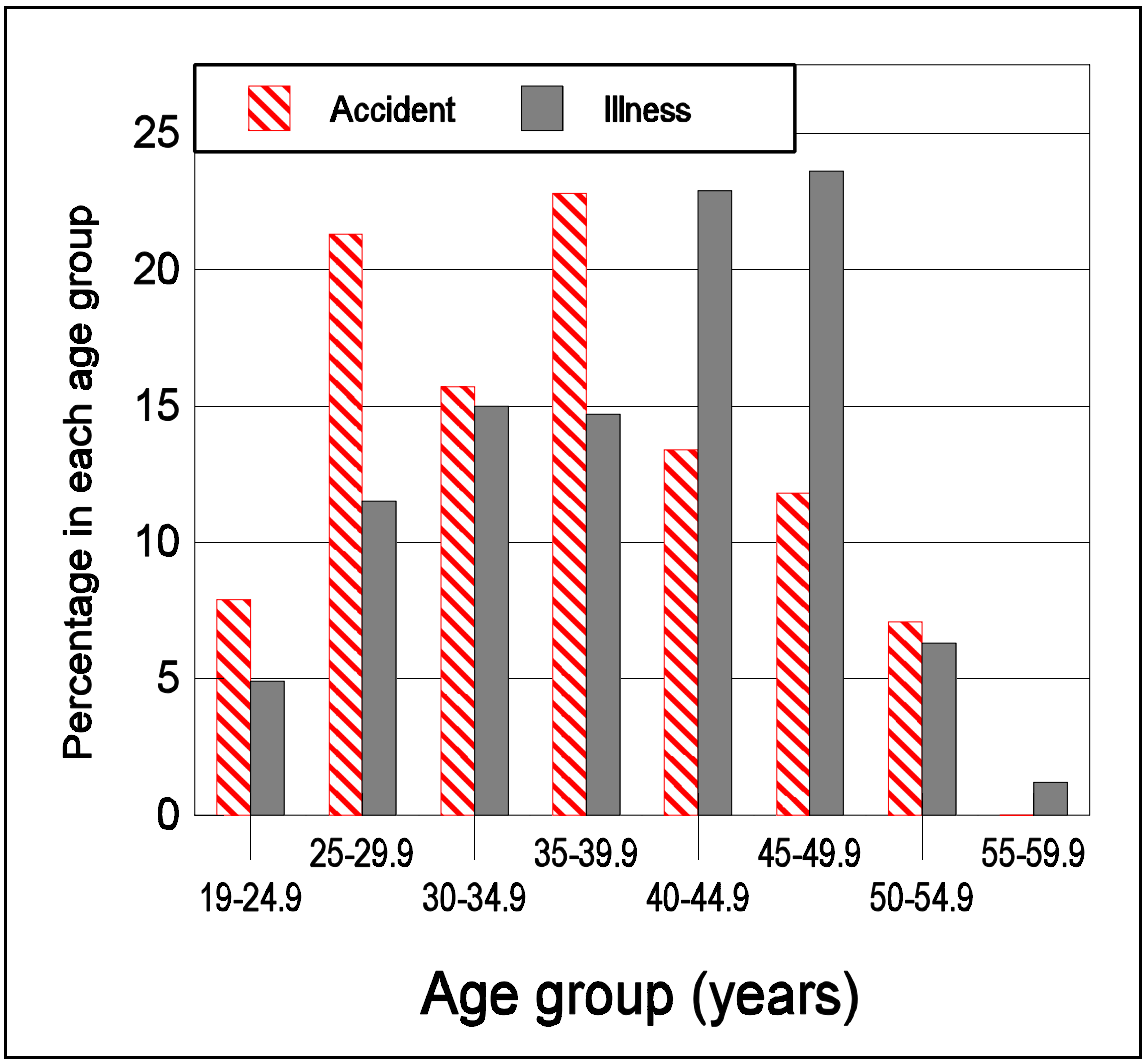


Figure 7.3
Percentages of accident and illness consultations in each age group

Work, health, and safety in the UK oil and gas industry:

A survey of onshore sites, and comparison with offshore installations

K. R. Parkes and J. Byron

2.8.1 Summary

To complement the study of psychosocial factors and health among offshore personnel, a similar study was carried out onshore. Survey data were collected from 909 personnel employed by five operating companies at eight oil and gas processing sites on the UK mainland. As in the offshore survey, the data included a range of psychosocial measures, including physical environment stressors and job characteristics (workload, autonomy, task skill/variety, and clarity), safety measures and procedures, job satisfaction and future job prospects, and mental and physical health. A detailed analysis of the findings from the onshore sample is presented in the report.

In addition, data relating to psychosocial factors, health, and safety perceptions among offshore personnel working on production platforms (n=774) were compared with those from onshore personnel (n=836). The same six job types and five operating companies were represented in both data sets, but the age profile of the onshore group was older than that for the offshore group (average ages: 42.9 yrs. onshore; 39.8 yrs. offshore). Differences between the onshore and offshore environments, and the role of operating companies and job types in influencing onshore/offshore differences were evaluated.

The main findings from this comparison are summarised below. In interpreting these findings, it should be noted that higher medical standards are required of offshore personnel than those working onshore. Moreover, the onshore data were collected some four years later than the offshore data, and organizational changes took place in the oil and gas industry, both onshore and offshore, during these years.

2.8.2 Key findings

Job satisfaction. Overall, job satisfaction scores were higher, and job/career prospects scores lower, offshore than onshore but the nature and magnitude of these effects depended on job type, operating company, and day/night shiftwork vs. day work. As shown in Figure 8.1, work perceptions acted as mediating variables in the relationship between these factors and job satisfaction.

Work perceptions and safety measures. The magnitude (and, in some cases, the direction) of differences between the onshore and offshore environments in physical stressors, work characteristics, and safety measures depended on job type and/or operating company. However, in general, offshore personnel reported greater exposure to physical stressors, but lower workload, higher autonomy, and greater satisfaction with safety than the onshore personnel (see Figures 8.2 - 8.5). For production operators (whose range of plant operating and control tasks are similar onshore and offshore), perceptions of physical stressors, workload and autonomy differed very little between the two locations.

Health measures. The proportion of potential clinical 'cases' (as assessed by a standard symptom checklist) was higher onshore (17.5%) than offshore (14.5%), but this difference was only marginally significant. Measures of anxiety and somatic symptoms were significantly higher onshore than offshore after taking into account job types, companies, age and neuroticism. Musculo-skeletal and gastric problems were significantly less likely to be reported by offshore personnel than those onshore, but the opposite was true of sleep disturbance.

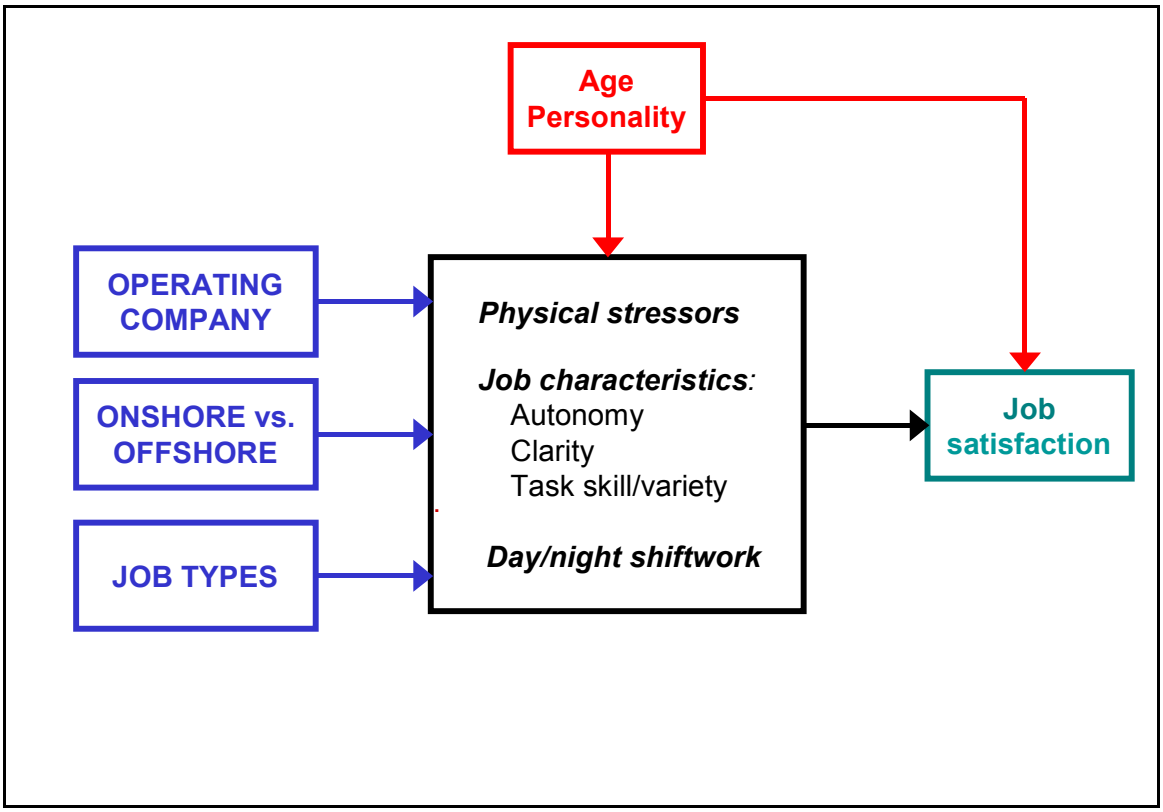


Figure 8.1
Diagrammatic representation of factors mediating the impact of job type, onshore vs offshore location, and company on job satisfaction

This diagram illustrates the role played by subjective work perceptions in mediating relations between occupational factors (operating company, onshore vs. offshore location, and job type) and job satisfaction. Thus, occupational factors influence perceptions of physical stressors and job characteristics, and the shift patterns worked, and these factors in turn influence job satisfaction. Age and personality (particularly neuroticism) influence job satisfaction both directly, and through their impact on perceptions of job characteristics.

Health behaviours. The proportion of smokers was significantly higher (31.3%) among offshore personnel than among those onshore (20.7%). Among younger personnel, but not among those over 50 years, onshore personnel had significantly higher mean body mass index (BMI) values than offshore personnel. Overall, 12.7% of the onshore group were obese (BMI > 30), as compared with 8.2% of the offshore group.

Sleep patterns. There were significant differences in sleep patterns between onshore and offshore shift workers. In particular, onshore personnel reported shorter night-shift sleep duration (5.7 hours on average) than offshore personnel (6.6 hours). More detailed analyses suggested that the offshore environment facilitates circadian adaptation among day/night shift workers relative to that of onshore shift workers.

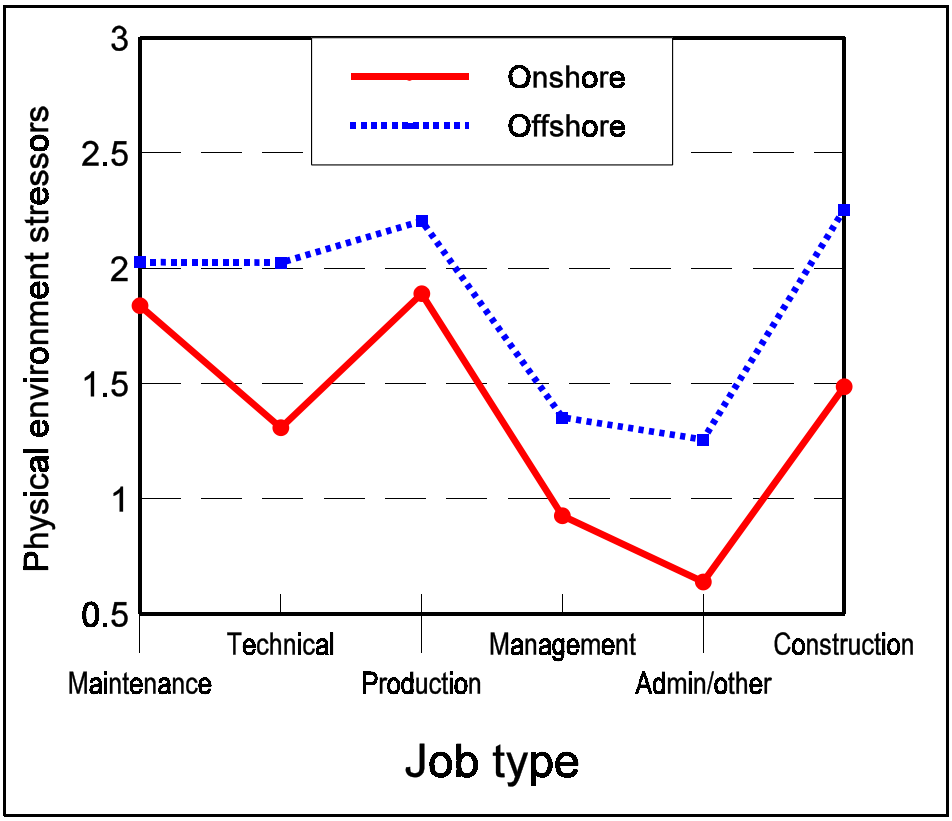


Figure 8.2
Physical stressors onshore and offshore in relation to job type

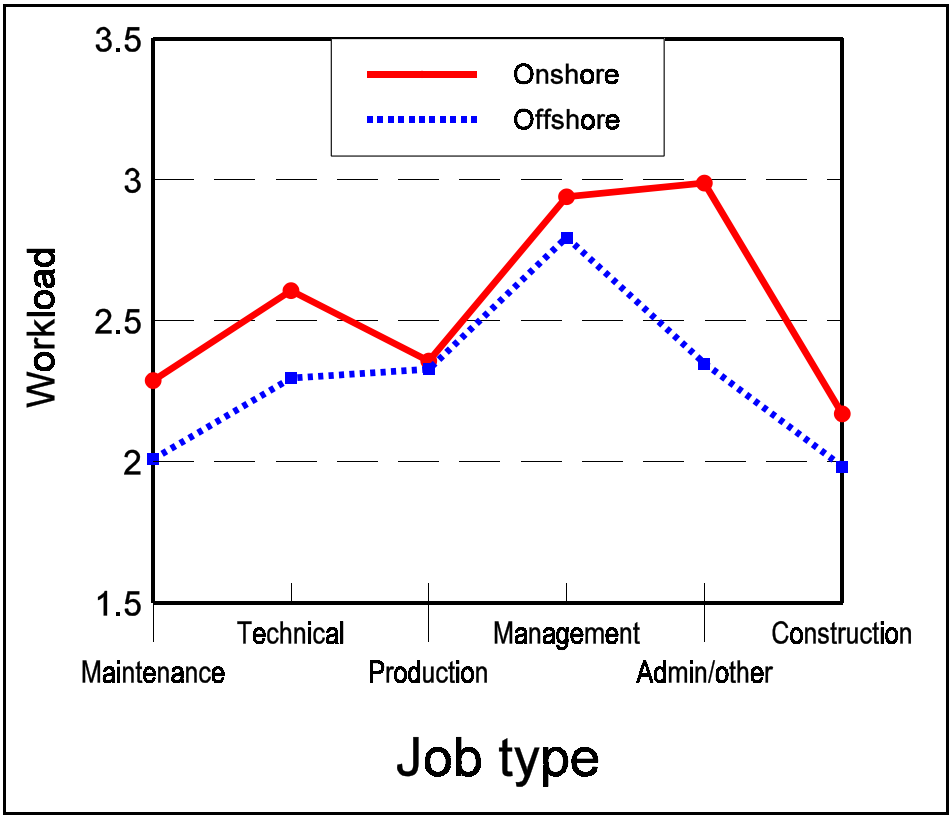


Figure 8.3
Workload onshore and offshore in relation to job type

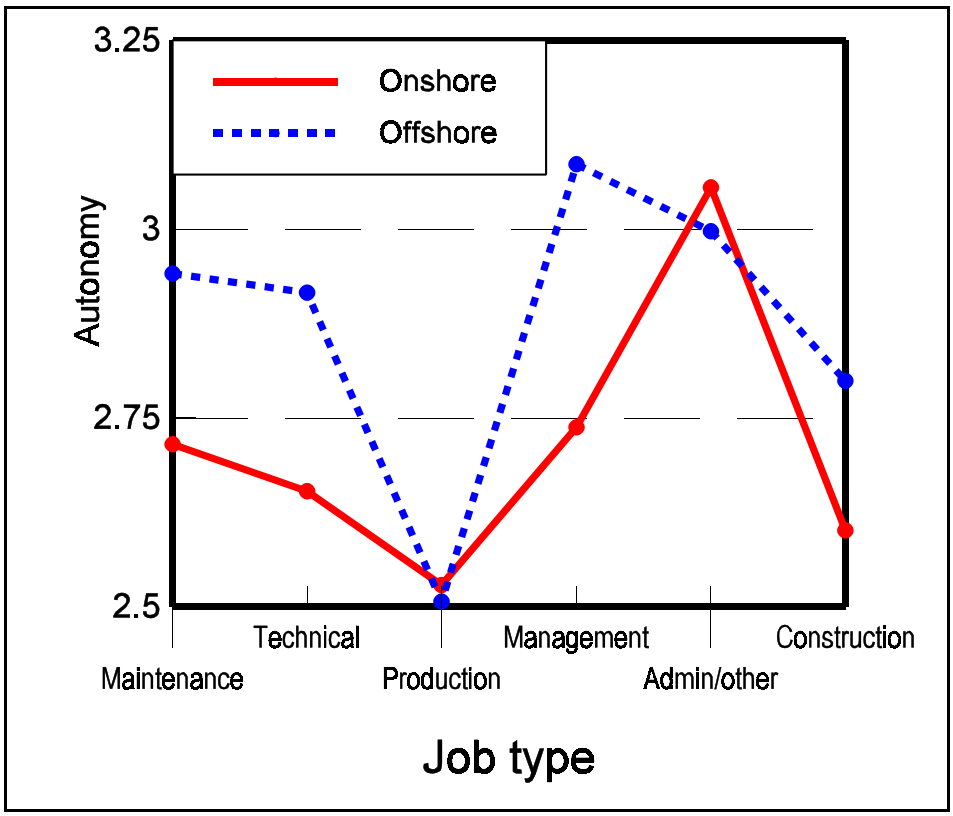


Figure 8.4
Autonomy onshore and offshore in relation to job type

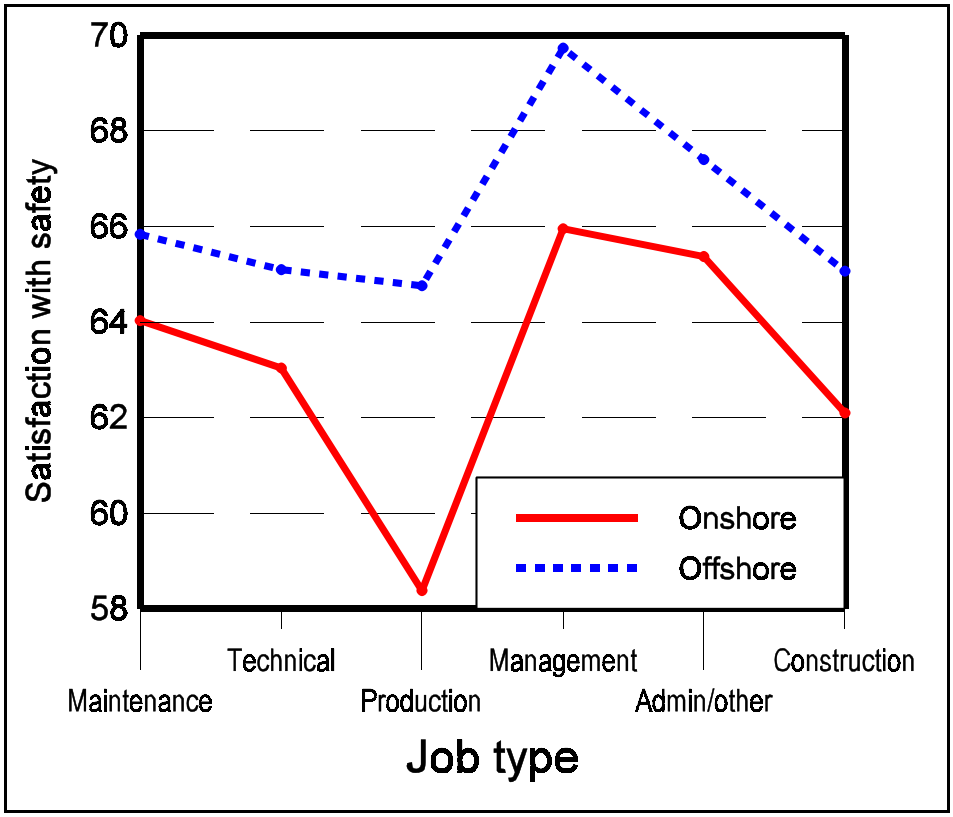


Figure 8.5
Satisfaction with safety onshore and offshore in relation to job type

Health, safety, and the changing work environment: A preview of longitudinal findings

K. R. Parkes and S. C. Carnell

2.9.1 Summary

The oil and gas industry has undergone considerable re-structuring, including down-sizing, in recent years. To evaluate the effects of these changes on the psychosocial work environment and the health of offshore personnel, a follow-up survey of participants in the 1995-6 study (described in Part IV of this series of reports) was carried out in 2000. This survey assessed job characteristics, physical work environment, safety issues, job satisfaction, and physical and mental health, using the same scales as in the earlier work.

Attempts were made to contact all personnel who, at the time of the 1995 survey, had agreed in principle to participate in any further study (N=1034); however, many of the individuals concerned either could not be traced or failed to respond to an initial letter. A total of 359 personnel completed follow-up questionnaires; 291 were still working offshore, and 32 had moved onshore to onshore jobs. Of the remainder, some had taken jobs outside the oil industry (n=18), and some had retired (n=12) or were unemployed (n=6).

Analysis of these data is still in progress; the preliminary results reported here focus on participants still working offshore at the time of follow-up. The findings present a mixed picture of offshore conditions in 2000, and the changes that have taken place since 1995. For instance, exposure to adverse physical work conditions decreased, but so also did satisfaction with safety measures and procedures. Changes on several measures of work characteristics and well-being were dependent on job situation in 2000; in general, personnel moving from non-management roles in 1995 to management/supervisory positions in 2000 experienced the most favourable changes. Other types of job change (e.g. moving to a new job) were also associated with favourable changes in perceived work conditions, but those remaining in the same job reported little or no such change. Increased workload and decreased job clarity (reflecting greater quantity and complexity of work) were greatest among those taking on management roles; this pattern of change in job characteristics is often associated with increase in job satisfaction.

Other factors also influenced outcome measures. For example, installation type (i.e. platforms vs. drilling rigs) and employer (i.e. operator vs. contractor) were related to change in satisfaction with job prospects; and older age was associated with negative change on a number of physical health measures.

2.9.2 Key findings

Physical environment. Reported exposure to physical environment stressors decreased among all offshore participants. Decrease was particularly marked among those changing to management positions during the five-year follow-up period.

Job characteristics. There were significant increases in workload and task skill / variety (Figures 9.1 and 9.2) from 1995 to 2000; these changes were most evident among those who had changed jobs. There was also an overall decrease in job clarity across all groups.

Satisfaction with safety. There was an overall decrease in satisfaction with safety and emergency response measures. However, personnel on production platforms and drilling rigs showed different patterns of change in relation to specific concerns (see Figure 9.3). For example, between 1995 and 2000, satisfaction with first aid training decreased to a greater extent on drilling rigs than on platforms; in contrast, platform personnel showed larger decreases in satisfaction with safety routines, safety instructions/training, follow-up of accidents, and medical services. However, in interpreting the findings shown in Figure 9.3, it is important to note that there was considerable variation between different installations in the extent of change across individual items.

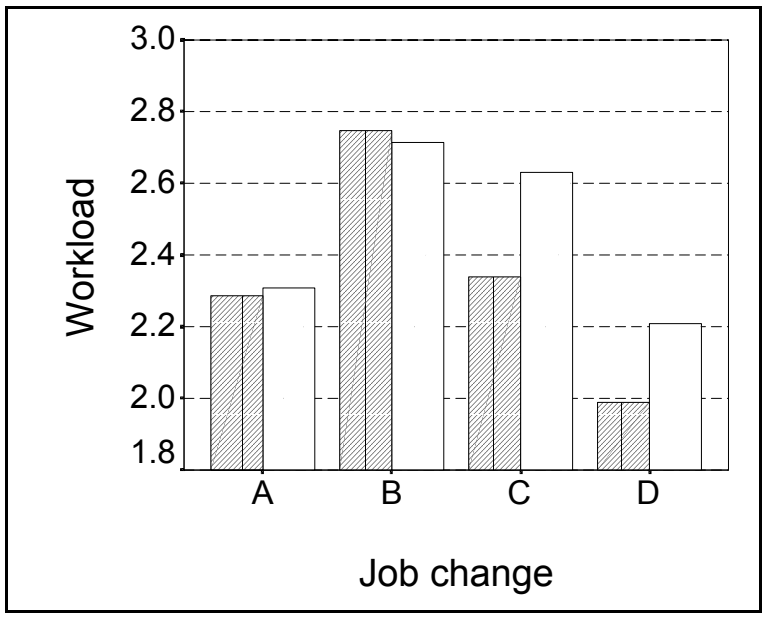


Figure 9.1
Workload levels1995 and 2000 in relation to job change

Figure 9.2
Task skill/variety 1995 and 2000 in relation to job change

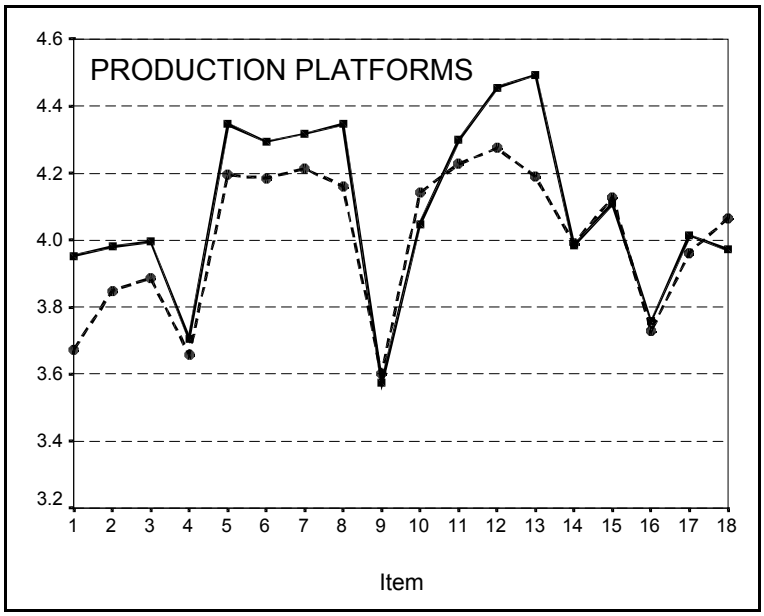
Key to job changes:

A Non-management job, 1995
No change, 1995-2000

B Management/supervisory job, 1995
No change, 1995-2000

C Non-management job, 1995
Promotion to management before 2000

D Non-management job, 1995
Change in job type before 2000



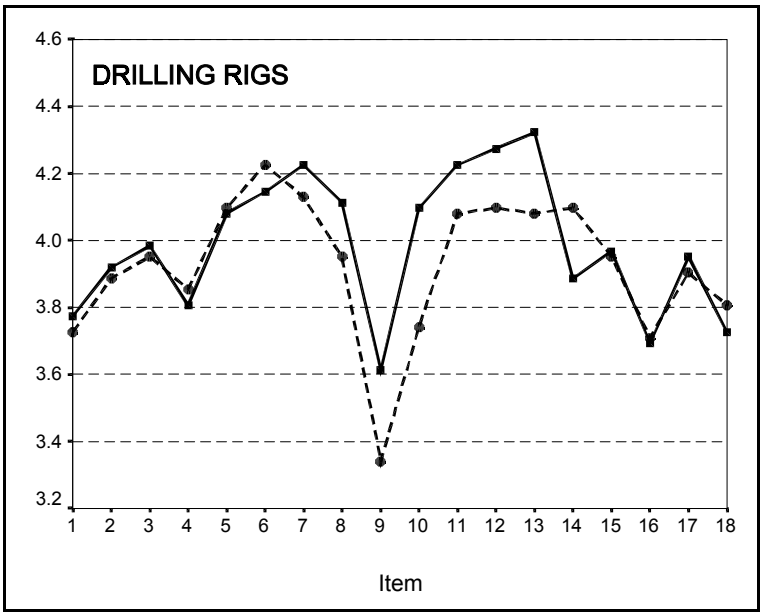


Figure 9.3
Mean scores on items assessing satisfaction with safety in 1995 and 2000 in relation to installation type

——— 1995 - – - - - 2000

Key to safety / emergency response items

1 Control and inspection routines for safety
2 Safety instructions/training
3 Measures taken after injuries and accidents
4 Housekeeping at the work place
5 Machine protection and safety devices
6 Markings and signs (e.g. for escape routes)
7 Escape routes on the installation
10 Medical services
11 Ease of access to personal safety equipment
12 Reliability of the alarm system
13 Fire/gas detection and deluge systems
14 Permit to work system
15 Temporary refuge (TR)
16 Emergency escape training

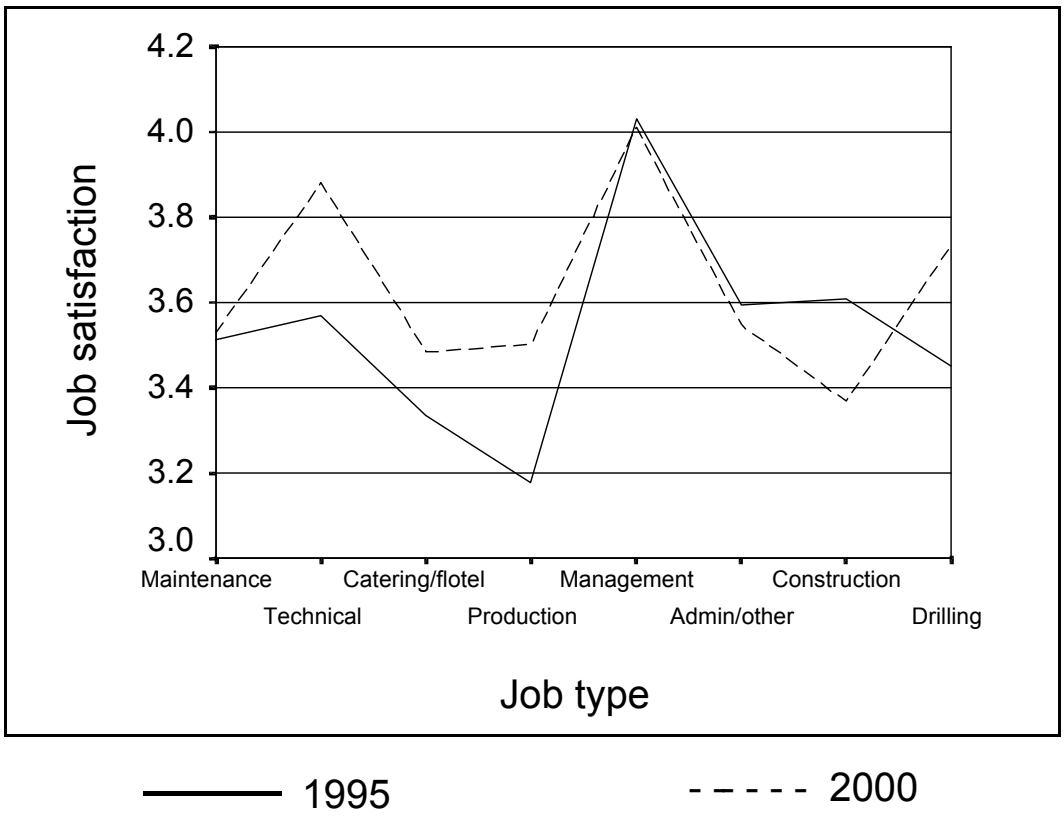


Figure 9.4
Change in job satisfaction 1995-2000 in relation to job type in 1995

Psychological well-being

Job satisfaction. Changes in job satisfaction were influenced by job type in 1995, and by job changes between 1995 and 2000. In general, change of job was associated with increased job satisfaction. Among those who did not change jobs, job satisfaction increased for technical, production and drilling personnel, but decreased for construction workers (see Figure 9.4).

Mental health. Among those who continued working offshore, there was a significant increase in anxiety between 1995 and 2000. However, this overall change was largely due to increased anxiety among personnel in production, maintenance, management and administration job types. There was also a trend towards an increased proportion of potential 'cases' (i.e. clinical or near-clinical levels of psychological distress, often considered to reflect stress) from 15.4% to 19.2%, but this increase was not statistically significant.

Physical health

The proportion of participants reporting musculo-skeletal disorders (e.g. back pain) increased significantly from 1995 to 2000, most probably reflecting the normal ageing process over the five-year follow-up period, although specific work-related changes could also be implicated. Changes in incidence of headache, gastric, and sleep problems were not significant overall.

Again, consistent with the normal process of ageing, there was a significant increase in mean body mass index (BMI) from 26.1 kg/m^2 to 26.8 kg/m^2 between 1995 and 2000. The average increase in BMI of 0.7 kg/m^2 was highly significant statistically, and was equivalent to a weight increase of 2.2 kg over the five-year period.

3. GENERAL CONCLUSIONS

The series of studies summarised in this document present a wide-ranging picture of the North Sea work environment and the particular demands it imposes on offshore personnel. In doing so, it draws on existing literature and on studies using a variety of empirical research methods including interviews, questionnaire surveys, detailed assessments of mood and performance across day and night shifts, and analysis of archival data relating to accidents and injuries, and to sickbay consultations. Several important issues cut across more than one study; this final section seeks to bring together some general conclusions in relation to temporal and occupational factors of major significance in relation to health and safety outcomes.

3.1 Temporal factors in offshore work

Shift work. The design and implementation of shift rotation schedules is an issue of major importance offshore, and one in which it is necessary to take into account not only the demands imposed by circadian adaptation, but also social and family preferences, and logistic considerations. In the present studies, two issues were of particular importance in relation to offshore shift work; first, comparisons between personnel working day/night rotating shifts and those working only day shifts; and second, the effects of different day/night shift rotation patterns.

- *Day/night rotating shifts vs. day shifts.* Consistent with other findings, personnel working day/night rotating shifts were more likely to report sleep disturbance and gastric problems than those working only day shifts. More positively, however, comparisons across onshore and offshore shift work, indicated that the offshore environment tends to facilitate adjustment of sleep patterns to the circadian changes imposed by day/night shift work. Moreover, the prevalence of other minor health problems did not differ between day-shift and day/night shift personnel.

  There was also no evidence of mental health differences between these two groups, but analysis of archival data indicated that injuries occurring during night-shift work were more likely to be severe (i.e. fatality or serious injury as compared with 3+ day injury) than those occurring during day shifts. Consistent with this finding, day/night shift workers were not only more likely to visit the installation sickbay than day workers, but were also more likely to do so as a result of accidents than day workers.

- *'Rollover' vs. fixed-shift rotation patterns.* A detailed comparison of the two main shift rotation patterns in operation offshore (i.e. rollover patterns involving mid-tour change of shift and 'fixed-shift' schedules in which either day or night shifts are worked for the entire two-week tour) in terms of patterns of mood and performance across successive shifts formed a major part of the present work This study demonstrated clearly that fixed-shift patterns are less detrimental to sleep, alertness, and performance than rollover patterns (irrespective of whether night shifts or day shifts are worked during the first week). However, it should be noted that the preference of offshore personnel for going home daytime adjusted is very strong (particularly among those working on production platforms), and this can only be achieved by the 7 nights /7 days 'rollover' pattern. Nonetheless, long-term health is also important, and fixed-shift patterns halve the number of circadian adjustments required, a major issue in view of increasing evidence that day/night shift work is associated with increased risk of cardiovascular illness, and that the demands of adjusting to circadian change may underlie this health hazard.

Overall, the results of the various studies carried out suggest that day/night shift workers, particularly those working 'rollover' shift patterns, are at greatest risk of adverse outcomes, although to what extent impaired sleep, alertness, and performance impact directly on health complaints, accidents, and injury rates (and consequently in increased sickbay consultations) could not be determined from the available data.

Long work hours. The present study documented the long work hours reported by a high proportion of offshore personnel, particularly managers (nearly half this group reported working in excess of 100 hours per week). Published research highlights the adverse implications for mood and performance of long work hours in onshore work settings, and the particular demands imposed by the offshore environment would be expected to intensify such effects; thus, long work hours could pose particular hazards for managers who are responsible for the safety and smooth-running of the installation.

Work leave schedules. The empirical data reviewed confirmed the marked preference for 2-2 as opposed to 3-3 working among offshore personnel, but also showed that this preference was much stronger on production platforms than on drilling rigs. Interviews with spouses of offshore personnel identified specific concerns about 3-3 working, but a number of other concerns were equally important in this group. More generally, problems of introducing 3-3 working appear to be confounded by the fact that less productive installations are under more pressure to reduce costs by moving to 3-3 schedules; consequently, there has been a tendency to introduce 3-3 schedules on installations on which the personnel are already demoralised. The longer schedules might be more favourably received on new installations with high morale and no previous history of 2-2 working.

The analysis of archival data relating to accidents and injuries also provided information potentially relevant to the issue of 3-3 working. Thus, for tour durations of greater than 14 days, the ratio of fatalities and severe injuries relative to less severe (3+ day) injuries was markedly higher than that for tour durations of 2 weeks or less**.** Whilst this result may represent a causal effect of cumulative fatigue (and, if so, would have relevance to the issue of 3-3 working), other explanations are also possible. For instance, personnel who remain offshore for more than two weeks may be in job categories that place them at particular risk. It is also possible that longer tour durations may be more common among some groups of specialist personnel who travel to different installations as required, and are consequently less familiar with local procedures and equipment than those regularly employed on the same installation. On the other hand, a cumulative fatigue explanation is consistent with the trend towards decreased alertness during the third week offshore as compared with the first and second weeks (see Figure 5.2).

3.2 Job types

The results presented in this summary report serve to highlight the extent to which different occupational groups experience different work conditions and health outcomes. Thus, personnel in the eight different jobs groups differed significantly in levels of physical environment stressors, perceived job characteristics, safety perceptions, job satisfaction and satisfaction with job/career prospects, mental and physical health, sickbay consultations, and accidents/injury rates. Some general findings are reviewed below.

Work perceptions, job satisfaction and mental health. Management and catering staff reported particularly high workload levels on production platforms; however, whereas managers also tended to have high autonomy and control over their work, this was not true of catering staff who had particularly adverse job conditions of 'high job demand and low job control'. Managers were also more optimistic about their future job prospects, and more satisfied with safety measures and procedures, than most other personnel. In spite of these positive features, managers tended to show higher anxiety levels than personnel in most other job groups. Personnel whose work was primarily based in the accommodation areas (management, administration, and catering) were generally more satisfied with safety measures and procedures than those working in production, maintenance, drilling and construction areas.

Minor health problems. Production and drilling personnel had the highest overall scores on minor health problems and, in each case, sleep problems associated with shift work made a major contribution. After control for shift work, job type *per se* was associated with musculo-skeletal complaints, headaches, and work-related injuries. Relative to maintenance personnel (arbitarily taken as the comparison group), drillers were more likely to report musculo-skeletal problems, while catering personnel were less likely to report these problems. Managers and construction workers were most likely to report headaches (both groups having nearly double the risk of maintenance workers), while the overall impact of job type on injuries was entirely due to the high risk among construction workers (a threefold increase relative to maintenance workers).

Accidents and injuries. Analysis of the HSE database on offshore accidents and injuries also showed that work in different areas (production/maintenance, construction, and drilling) was associated with significantly different patterns of injury (e.g. sprains, cuts, burns, bruises, etc) and activity (e.g. handling goods, lifting, machinery). Moreover, sickbay consultations also reflected differences between job types, with high rates of accident consultations among construction personnel, and high rates of illness consultations among maintenance personnel. Thus, there were specific links between the demands of different jobs and the types of health problems and injuries reported.

3.3 Onshore / offshore differences

Although some findings (e.g. higher workload and lower levels of physical environment stressors at onshore sites as compared with offshore production installations) applied generally across all jobs and operating companies, other measures showed less consistent findings. Thus, companies and job types influenced the magnitude and direction of onshore/offshore differences on a number of measures (e.g. task variety, autonomy, and safety perceptions) with no overall pattern as to which environment was more favourable. This latter finding suggests that, for these measures at least, there are potential opportunities for interventions to enhance less favourable work situations irrespective of whether they are onshore or offshore.

3.4 Ageing

The age profile of the offshore workforce increased steadily through the 1980's and 1990's. Two related issues have thus become of particular importance over these decades; first, the extent to which age impacts on the ability of offshore personnel to cope with the demands of the offshore environment; and, second, the extent to which the offshore environment, particularly the long work hours and demanding shift schedules, may disproportionately impair the health of older offshore personnel as compared with their younger counterparts.

In general, the results of the studies summarised in this report suggest that the effects of ageing among offshore personnel are generally in line with those among comparable personnel working onshore. Thus, for instance, older personnel reported a greater incidence of minor health problems, were more likely to visit the sickbay for illness (but less likely to do so for injuries), reported poorer sleep and had higher body mass index; all these results would be expected to also apply to onshore groups. In terms of job satisfaction, older age groups reported greater satisfaction with work tasks and with job prospects than those in the middle age ranges.

Thus, there is little to suggest that older age groups are particularly disadvantaged in the offshore environment. However, this finding must be interpreted in the light of 'survival' effects, that is, older personnel who find it difficult to continue to adapt to the offshore lifestyle are more likely to retire or move to onshore work than those who do not experience such problems. This self-selection process results in a particularly 'healthy-worker' characteristics among older age groups offshore which may mask the true magnitude of the effects of ageing.

4. REFERENCES

4.1 Oxford University offshore research, funded by HSE-OSD

4.1.1 Reports summarised in this document

PARKES, K. R. (1996). Psychosocial aspects of work and health in the North Sea oil and gas industry. *Part I. A review of the literature*. Report OTH 96 523. Sudbury: HSE Books.

PARKES, K. R. & RAZAVI, T. D. B. (1996). Psychosocial aspects of work and health in the North Sea oil and gas industry. *Part II. A five-year follow-up study (1990-1995) of offshore and onshore personnel* Report OTH 96 530. Sudbury: HSE Books.

PARKES, K. R., CLARK, M. J. & PAYNE-COOK, E. (1997). Psychosocial aspects of work and health in the North Sea oil and gas industry. *Part III. Sleep, mood, and performance in relation to offshore shift rotation schedules.* Report 96 530. Sudbury: HSE Books.

PARKES, K. R., CLARK, M. J. & PAYNE-COOK, E. (1997). Psychosocial aspects of work and health in the North Sea oil and gas industry. *Part IV. The offshore environment in the mid-1990's: A survey of psychosocial factors.* Report 96 530. Sudbury: HSE Books.

PARKES, K. R. & CLARK, M. J. (1997). Psychosocial aspects of work and health in the North Sea oil and gas industry. *Part V. Offshore work/leave schedules: Data analyses and review.*

PARKES, K. R. & SWASH, S. (2000). *Injuries on offshore oil and gas installations: An analysis of temporal and occupational factors.* Contract Research Report, OTO 99-097.

PARKES, K. R. & BYRON, J. (2001). *Work, health and safety in the UK oil and gas industry: A survey of onshore sites, and comparisons with offshore installations*. Contract Research Report 314/2001. Sudbury: HSE Books.

4.1.2 Journal articles and other publications

PARKES, K. R. (1992). Mental health in the oil industry: A comparative study of onshore and offshore employees. *Psychological Medicine, **22***, 997-1009.

PARKES, K. R. (1994). Sleep patterns, shift work, and individual differences: A comparison of onshore and offshore control-room operators. *Ergonomics,* **37**, 827-844.

PARKES, K. R. (1995). *Work and well-being among offshore oil employees*. In: P. Collett & A. Furnham (Eds.) Social psychology at work. London: Routledge.

PARKES, K. R. (1998). Psychosocial aspects of stress, health and safety on North Sea installations. *Scandinavian Journal of Work, Environment & Health,* **24**, 321-333.

PARKES, K. R. (1999). Shiftwork, job type, and the work environment as joint predictors of health outcomes. *Journal of Occupational Health Psychology*, **4**, 256-268.

PARKES, K. R. (2001). Age, smoking, and negative affectivity as predictors of sleep patterns among shift workers in two environments**.** *Journal of Occupational Health Psychology*, **7**, 156-173.

PARKES, K. R. (2001). Shift work and age as interactive predictors of body mass index among offshore workers. *Scandinavian Journal of Work, Environment & Health*, **28**, 64-71.

4.2 General bibliography (offshore research)

ALEKPEROV, I. I., MELKUMYAN, A. N. & ZAMCHALOV, A. I. (1988). Some peculiarities of the physiological validity of shift work schedules for the crews of floating oil drilling platforms. *Journal of Hygiene, Epidemiology, Microbiology and Immunology, **32**,* 385-396.

BJORVATN, B., KECKLUND, G., & AKERSTEDT, T. (1998). Rapid adaptation to night work at an oil platform, but slow readaptation after returning home. *Journal of Occupational and Environmental Medicine*, **40**, 601-608.

COOPER, C. L. & SUTHERLAND, V. J. (1987). Job stress, mental health, and accidents among offshore workers in the oil and gas extraction industries. *Journal of Occupational Medicine*, **29**, 119-125.

COX, R. A. F. (1987). *Offshore medicine: Medical care of employees in the offshore oil industry. 2nd Edition*. London: Springer-Verlag.

THE HON. LORD CULLEN (1990). *The public enquiry into the Piper Alpha disaster*. London: HMSO.

FLIN, R. H. & SLAVEN, G. M. (1992). *Managing offshore installations: A survey of UKCS offshore installation managers*. Aberdeen: Robert Gordon Institute of Technology.

FLIN, R., MEARNS, K., GORDON, R. & FLEMING, M. (1995). *Risk perception in UK offshore workers*. Paper presented at a conference on 'Understanding Risk Perception', Aberdeen, 2 February 1995.

GANN, M., CORPE, U., & WILSON, I. (1990). The application of a short anxiety and depression questionnaire to oil industry staff. *Journal of the Society of Occupational Medicine,* **40***,* 138-142.

HELLESØY, O. H. (Ed.). (1985). *Work environment: Statfjord Field*. Bergen, Oslo: Universitets-forlaget.

HELLESØY, O., GRØNHAUG, K., & KVITASTEIN, O. (2000). Burnout: conceptual issues and empirical findings from a new research setting. *Scandinavian Journal of Management*, 16, 233-247.

HORSLEY, H. D. & MacKENZIE, I.G. (1996). *Lifestyle survey amongst North Sea oil workers*. In: Proceedings of the Occupational Health Offshore Conference, Aberdeen, 26-28 March 1996. Sudbury: HSE Books.

IVERSEN, E. (1991). Health, sick leave and work organization on a Norwegian oil field. In M. Johnston, M. Herbert, & T. Marteau (Eds.), *European Health Psychology* (pp.56-57). Leicester: Health Psychology Section, British Psychological Society.

LAURIDSEN, O., TRONSMOEN, S., BERLAND, J., GITLESEN, J .P., RINGSTAD, A. J., *et al.* (1991). *Shift-work and health: Shift-work, sleeping difficulties, psycho-social work environment and psychosomatic complaints*. Rogaland Research / Phillips Petroleum Company, Norway.

MCNABB, S. J., RATARD, R.C., HORAN, J.M., & FARLEY, T.A. (1994). Injuries to international petroleum drilling workers, 1988-1990. *Journal of Occupational Medicine*, 36, 627-630.

MILCAREK, B. (1993). Stress and tenure: A longitudinal study of Statfjord caterers. In: Storey, K. and Shrimpton, M. (Eds.), *Social, Psychosocial and Cultural Aspects of Health and Safety in the Offshore Oil Industry* (pp.76-87). St. John's: Memorial University of Newfoundland.

PARKES, K. R. (1993). Human factors, shift work, and alertness in the offshore oil industry. *Part I. A survey of onshore and offshore control-room operators. Part II. Alertness, sleep, and cognitive performance.* Report OTH 92-389. London: HMSO.

PARKES, K. R. (1997). "*Stress, health and the offshore work environment*". In: Proceedings of the Occupational Health Offshore Conference, Aberdeen, 26-28 March 1996. Sudbury: HSE Books.

RUNDMO, T. (1992). Risk perception and safety on offshore petroleum platforms - Part II: Perceived risk, job stress and accidents. *Safety Science*, **15**, 53-68.

SUTHERLAND, V. J., & COOPER, C. L. (1991). Personality, stress and accident involvement in the offshore oil and gas industry. *Personality and Individual Differences*, **12**, 195-204.

SUTHERLAND, K. M. & FLIN, R. H. (1989) Stress at sea: A review of working conditions in the offshore oil and fishing industries. *Work and Stress*, **3**, 269-285.

SUTHERLAND, V. J. & COOPER, C. L. (1989). Occupational stress in the offshore oil and gas industry. *International Review of Ergonomics*, **2**, 183-215.

TAYLOR, R. C., MORRICE, K., CLARK, D. & MCCANN, K. (1985). The psychosocial consequences of intermittent husband absence: An epidemiological study. *Social Science and Medicine, **20**,* 877-885.

ULLEBERG, P., & RUNDMO, T. (1997). Job stress, social support, job satisfaction and absenteeism among offshore oil personnel. *Work and Stress*, **11**, 215-228.

4.3 General bibliography (other relevant research)

COSTA, G. (1996). The impact of shift and night work on health. *Applied Ergonomics*, **27**, 9-16.

JEONG, B.Y. (1999). Comparison of variables between fatal and nonfatal accidents in manufacturing industry. *International Journal of Industrial Ergonomics*, **23**, 565-572.

HANECKE, K., TIEDEMANN, S., NACHREINER, F., & GRZECH-SUKALO Grzech-Šukalo, H. (1998). Accident risk as a function of hour at work and time of day as determined from accident data and exposure models for the German working population. *Scandinavian Journal of Work, Environment & Health*, **24** (Suppl. 3), 43-48.

MONK, T. H., & FOLKARD, S. (1992). *Making shift work tolerable*. London: Taylor and Francis.

NICHOLSON, P. J., & D'AURIA, D. A. (1999). Shift work, health, the working time regulations and health assessments. *Occupational Medicine London*, **49**,127-137.

PROCTOR, S. P., WHITE, R. F., ROBINS, T. G., ECHEVERRIA, D., & ROCSKAY, A. Z. (1996). Effect of overtime work on cognitive function in automotive workers. *Scandinavian Journal of Work, Environment & Health*, **22**, 124-132.

TENKANEN, L., SJOBLOM, T., & HARMA, M. (1998). Joint effect of shift work and adverse life-style factors on the risk of coronary heart disease. *Scandinavian Journal of Work, Environment & Health*, **24**, 351-357.

WATERHOUSE, J. M., FOLKARD, S., & MINORS, D. S. (1992). *Shiftwork, health and safety: An overview of the scientific literature 1978-1990*. HSE Contract Research Report No. 31/1992. London: HMSO.

WILLIAMSON, A. M. & FEYER, A. M. (1995). Causes of accidents and the time of day. *Work and Stress*, 9, 158-164.